



DoD Manufacturing Technology Program

Strategic Plan

July 2012

ManTech

*Delivering Advanced, Affordable
Manufacturing for the Warfighter*



PREFACE

This 2012 DoD Manufacturing Technology (ManTech) Program Strategic Plan complies with Section 2521(f) of Title 10, United States Code. It was prepared jointly by the office of the Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy (DASD(MIBP)) and the Joint Defense Manufacturing Technology Panel (JDMTP), comprised of ManTech Program leadership from each Military Department and the Defense Logistics Agency. Additional details regarding the plan's statutory requirements and the strategic planning construct guiding its development can be found in Annexes A and B, respectively.



The Fiscal Year (FY) 2011 National Defense Authorization Act (NDAA) transferred oversight responsibilities for the DoD ManTech Program to the DASD(MIBP). This significant change, coupled with other recent statutory adjustments (including formal codification of the JDMTP in the FY 2010 NDAA, as well as other transfers of responsibility to the DASD(MIBP) office in FY 2011), created new organizational synergies supporting the defense manufacturing and production interests of the Department. Those changes have fostered a more comprehensive approach to ensuring the health and resilience of the defense industrial base, manifested by ongoing Sector-by-Sector, Tier-by-Tier (S2T2) industrial base analyses led by the DASD(MIBP) office. This 2012 DoD ManTech Program Strategic Plan leverages these new organizational synergies while building on the complementary framework and momentum established by the 2009 DoD ManTech Program Strategic Plan. Strategic Thrust 1 has been restructured to focus joint ManTech activities more clearly on program responsiveness and balance across the family of manufacturing technology investment portfolios. This emphasis is then extended across three additional strategic thrusts in support of the Department's broader, advanced manufacturing enterprise needs. The plan's principal objective is to enable this cross-cutting DoD program to continue to create sustained, positive impacts for the warfighter in the rich tradition of its past while elevating ManTech's performance and value to the defense industrial base to even higher levels.

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FORWARD



ACQUISITION,
TECHNOLOGY
AND LOGISTICS

OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

Our Soldiers, Sailors, Airmen, and Marines remain globally engaged on multiple fronts and in diverse environments where they are supported by the most capable, dynamic, and competent industrial base in the world. In a time of intense budgetary pressure, one of our critical responsibilities is to monitor, engage, and, when necessary, co-invest in our industrial base to ensure those warfighters have the systems necessary to successfully execute their daily missions, now and in the future.

My office, Manufacturing and Industrial Base Policy (MIBP), supports this mission on behalf of the Under Secretary of Defense for Acquisition, Technology, and Logistics. A central element underpinning this mission is the Manufacturing Technology (ManTech) Program. For over 50 years, the DoD ManTech Program has been the Department's investment mechanism for staying at the forefront of defense-essential manufacturing capabilities. ManTech focuses on enabling the affordable and timely development, production, and sustainment of defense systems, thereby enhancing our technological edge in a dynamic, diverse, and evolving threat environment.

This strategic plan is the Department's formal vehicle to unify and guide the ManTech community in its support of the broader defense industrial base to deliver maximum value to the warfighter and the nation. Additionally, this plan also leverages the organizational changes contained in the 2011 National Defense Authorization Act to ensure responsiveness to the Department's current and future industrial base needs. Changes include the establishment of my position as Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy (DASD(MIBP)) and assignment of oversight responsibilities over the DoD ManTech Program to MIBP.

One of the key thrusts of the DASD(MIBP) office's mission is to partner with industry to inject a spirit of innovation into the defense industrial base to ensure our warfighters are the beneficiaries of the best technology advancements that industry can provide at the best value for the taxpayer. I see ManTech as key to fostering that innovation to meet the challenges of our changing world and ensure our nation maintains its competitive edge on the battlefield. I am pleased to lead and be a part of the ManTech team, which continues to enhance our defense industrial base for the protection of this nation's future.

A handwritten signature in blue ink, reading "B. Lambert".

Brett B. Lambert
Deputy Assistant Secretary of Defense
Manufacturing and Industrial Base Policy

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I. INTRODUCTION

*A 50+ year heritage of
essential contributions to
defense manufacturing...
...adapting to
21st century demands.*

For over fifty years, the DoD Manufacturing Technology (ManTech) Program has been the Department's investment mechanism for staying at the forefront of defense-essential manufacturing capability. Defense acquisition programs rely on innovative manufacturing capabilities and an industrial base that can deliver them. In the 20th century, when the threat was highly predictable and the U.S. defense industrial base was largely self-contained, ManTech helped keep the nation positioned to produce the best military systems in the world. In the 21st century, DoD faces a range of strategic, conventional, and asymmetric challenges. To address these challenges and equip America's warfighters, program managers are tapping an industrial base which is globally networked and diverse. Compounding this complexity is the increasing imperative to consider affordability in the Department's science and technology, acquisition and sustainment plans. These are the new demands placed on defense manufacturing, and they are shaping the role of ManTech.

This strategic plan defines the ManTech strategy for keeping DoD positioned to use and enhance 21st century advanced manufacturing capabilities while addressing the growing challenges of weapon system affordability and timely delivery to the warfighter. It is structured to unify and guide the DoD ManTech community and the extended defense manufacturing enterprise in the broad

ManTech strategic planning is focused on the imperatives to improve weapon system affordability and timely delivery to the warfighter.

The strategy builds upon initiatives and momentum established by the 2009 strategic plan.

context of 21st century national defense needs. Manufacturing is so important to the nation's economic and national security that the ManTech community is sometimes looked to as the champion not only for defense manufacturing technologies, but for the defense industrial base or even more widely for enhancing U.S. global manufacturing competitiveness. These broader topics extend well beyond the charter of ManTech, but they form an important strategic context for ManTech planning.

This strategic plan was developed through a process of top down analysis and senior level stakeholder interviews, starting with identifying requirements and assessing defense manufacturing needs and capability gaps, all within the context of national and global manufacturing trends. It recognizes ManTech's tremendous leveraging value to the Department and builds upon the initiatives and momentum established by the program's 2009 strategic plan. For example, the Advanced Manufacturing Enterprise (AME) Subpanel supporting the Joint Defense Manufacturing Technology Panel (JDMTP) was formed largely in response to Strategic Thrusts 2, 3, & 4 in the 2009 strategy, and this 2012 strategic plan places continued emphasis on AME. This strategy also continues to call for maintaining a more robust relationship with the DoD systems engineering community and other important partners across ManTech's extended landscape of government, industry and academic interests and activities. Lastly, the 2012 joint strategy capitalizes on the new organizational synergies created by the establishment of the DASD(MIBP) office—the OSD ManTech Office's new parent organization—and strives to further refine the important balance between ManTech's development of leading edge processing and fabrication technologies (the program's core deliverable) and active support for the Department's broader, advanced manufacturing enterprise needs.

This plan begins with a review of the strategic environment in which ManTech operates and its role within this environment. That review is followed by a presentation of the strategic thrusts and goals which are the core of this document. The plan concludes with a discussion of key mechanisms to support progress and assess program effectiveness. Annexes provide more detailed background information, including relevant statutory language; the process followed to develop this plan; a description of the office of the Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy (DASD(MIBP)); a summary of important DoD ManTech Program processes and procedures; the descriptions of the Component ManTech programs themselves, including the

mission focus and investment areas of each; manufacturing-related research and development (R&D) activities within the Defense Advanced Research Projects Agency (DARPA);¹ and finally, salient shaping and reference documents.

In summary, ManTech brings affordable, defense-critical manufacturing technologies to acquisition and sustainment managers and bridges the gap between technology discovery and the delivery of new capabilities to the warfighter. Within that context, this strategic plan highlights the program's key roles and potential, advancing a ManTech strategy to best meet the short-term and long-term advanced manufacturing needs of the Department.

¹ Although DARPA manufacturing-related activity does not fall within the formal DoD ManTech Program directed by 10 U.S.C. § 2521, DARPA's portfolio of highly advanced manufacturing R&D investments (supporting typically higher risk and more ambitious invention and innovation) drives important relationships between the agency and the DoD ManTech Program; hence, it is a recognized and long-standing ex-officio member of the JDMTP.

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II. THE DEFENSE MANUFACTURING ENVIRONMENT AND MANTECH'S ROLE WITHIN IT

“America’s security and prosperity are increasing[ly] linked with the health of our technology and industrial bases. In order to maintain our strategic advantage well into the future, the Department requires a consistent, realistic, and long-term strategy for shaping the structure and capabilities of the defense technology and industrial bases—a strategy that better accounts for the rapid evolution of commercial technology, as well as the unique requirements of on-going conflicts.”

- 2010 Quadrennial Defense Review (QDR) Report ²

THE DEFENSE MANUFACTURING ENVIRONMENT

The above message in the 2010 QDR Report set an important tone when, for the first time in the series of QDR reports, it addressed the imperative to strengthen the defense industrial base and fundamentally linked its health to the Department’s national security mission. As the U.S. draws down from extended operations in Iraq and Afghanistan and budgets tighten, the nation finds itself at an inflection point. The U.S. faces a complex and uncertain security landscape, as suggested in the following graphic. Addressing the diversity of demands

² 2010 Quadrennial Defense Review Report, Department of Defense, p. xv.



of this environment clearly requires a strong and responsive industrial base capable of meeting the full spectrum of warfighter needs. Complicating the picture, the DoD is entering a period of fiscal austerity, reversing a decade of sustained growth in the defense budget. Over the next five years, total U.S. defense spending (both base funding and overseas contingency operations) is projected to drop by about 22% from its peak in 2010 after accounting for inflation.³ Thus, a key challenge for the Department will be to resource and provide for a wide breadth of warfighter requirements amidst intense fiscal constraints.

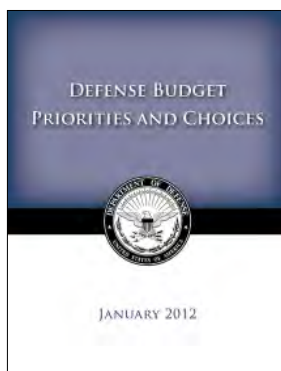
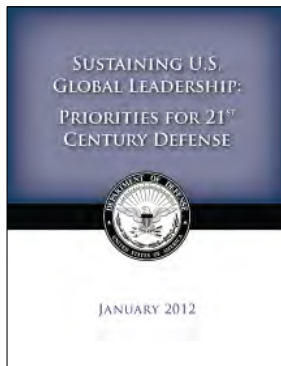
"We must therefore strive to achieve what economists call productivity growth: in simple terms, to DO MORE WITHOUT MORE."

Dr. Ashton Carter, then USD(AT&L)

Recognizing that the DoD budget would not continue the growth seen in the decade following September 11, 2001, then Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)) Ashton Carter released a series of Better Buying Power (BBP) memorandums in 2010 and 2011 that called for various acquisition system reforms and efficiency measures. Dr. Carter stated, "to put it bluntly: we have a continuing responsibility to procure the critical goods and services our forces need in the years ahead, but we will not have ever-increasing budgets to pay for them. We must therefore strive to achieve what economists call productivity growth: in simple terms, to DO MORE WITHOUT MORE."⁴ Technology must be affordable and producible, while ensuring that U.S. military forces have the capabilities to stay agile, deployable, sustainable, lethal, and dominant.

³ Defense Budget Priorities and Choices, Office of the Secretary of Defense, January 2012.

⁴ Carter, Ashton, "Better Buying Power: Guidance for Obtaining Greater Efficiency and Productivity in Defense Spending, Acquisition, Technology, and Logistics," Department of Defense, September 14, 2010.



The Secretary of Defense's (SECDEF) January 2012 release of new strategic guidance along with the Department's Fiscal Year 2013 Budget not only reinforced the need to sustain the vast majority of DoD's diverse set of mission-driven warfighter capabilities, but they also validated the BBP vectors established by the USD(AT&L) in 2010 and 2011. The new guidance addresses difficult force structure decisions while underscoring affordable modernization, technological advantage, and industrial base resilience as vital priorities. This guidance establishes imperatives for the defense industrial base to:

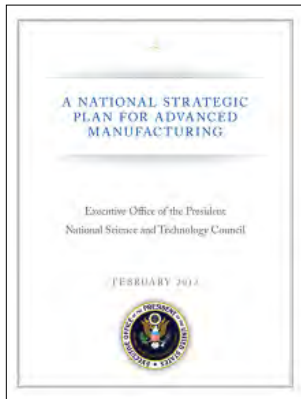
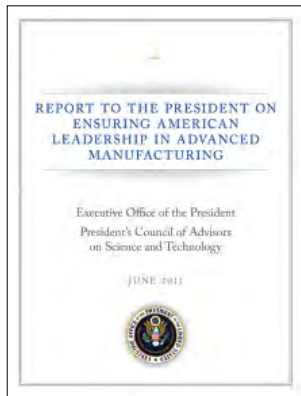
- affordably deliver defense-essential warfighter capabilities,
- continue to foster high levels of technical innovation, and
- possess key characteristics of "reversibility" enabling the regeneration of defense production capabilities when needed.⁵



The summary takeaway is that ensuring the health and resilience of the defense industrial base—a vast and extremely diverse enterprise of thousands of companies providing products and services, directly and indirectly, to national security agencies—is an increasingly critical underpinning of the Department's strategy to affordably develop, produce, field, and maintain high-quality equipment and systems to meet 21st century national security challenges.

Parallel themes are emerging across the federal sector, and the Administration has signaled the importance of advanced manufacturing to the economic and

5 Sustaining U.S. Global Leadership: Priorities for 21st Century Defense, Office of the Secretary of Defense, January 2012.



national security of the United States through numerous recent reports, speeches, and initiatives. Key examples include the President's Council of Advisors on Science and Technology (PCAST) 2011 report, *Ensuring American Leadership in Advanced Manufacturing*,⁶ the 2011 establishment of the President's Advanced Manufacturing Partnership (AMP) initiative across government, industry and academia,⁷ the 2012 State of the Union Address emphasis on manufacturing's importance to the nation, the 2012 release of the National Science and Technology Council's (NSTC) *National Strategic Plan for Advanced Manufacturing*,⁸ the formation of the Department of Commerce-hosted Advanced Manufacturing National Program Office (AMNPO) supported by DoD and other Interagency partners, and the Administration's 2012 announcement of the formation of a National Network for Manufacturing Innovation (NNMI)⁹, including the DoD-led establishment of a pilot "Institute for Manufacturing Innovation" (focused on additive manufacturing technologies) that will help inform the broader NNMI initiative. All of these serve to underscore the critical role of advanced manufacturing to enable U.S. industry to maintain its edge in a hypercompetitive global environment and meet vital economic and national security needs.

Recent statutory action by Congress has also helped the Department to ensure defense industrial health and advanced manufacturing capabilities in support of the Department's core mission going forward. To that end, the 2011 National Defense Authorization Act (NDAA) established the position of Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy (DASD(MIBP)) under the USD(AT&L). This statutory change significantly expanded the responsibilities of the previous DASD for "Industrial Policy" by:

- transferring to it OSD's oversight of the DoD ManTech and Defense Production Act (DPA) Title III programs;¹⁰

6 Report to the President on Ensuring American Leadership in Advanced Manufacturing, Executive Office of the President, President's Council of Advisors on Science and Technology, June 2011.

7 <http://www.whitehouse.gov/the-press-office/2011/06/24/president-obama-launches-advanced-manufacturing-partnership>.

8 A National Strategic Plan for Advanced Manufacturing, Executive Office of the President, National Science and Technology Council, Feb. 2012.

9 <http://www.whitehouse.gov/the-press-office/2012/03/09/president-obama-announce-new-efforts-support-manufacturing-innovation-en>.

10 Both of which previously were overseen by the DDR&E (now the ASD(R&E)).

- assigning responsibility to carry out the activities of the DoD relating to the Defense Production Act Committee (DPAC), a body recently established by Congress;¹¹ and
- assigning the responsibility to establish policies related to the Department's industrial independent research and development (IR&D) programs.¹²

As such, the DASD(MIBP) is now the principal advisor to the USD(AT&L) for the DoD ManTech and DPA Title III programs (among other activities). The collective addition of the DoD ManTech and DPA Title III programs as well as DPAC support responsibilities logically supported the addition of the word "Manufacturing" to the DASD's official title and drove the creation of a new 'Manufacturing Directorate' within ODASD(MIBP),¹³ expanding DASD(MIBP)'s basic functional domains from two (Assessments and Transactions) to three (including Manufacturing), as reflected in Figure 1.

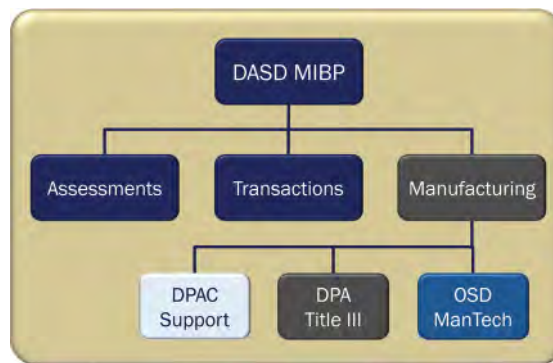


Figure 1. ODASD(MIBP) Organization

These statutory changes—strategically significant for the DoD ManTech Program—created a new leverage point in the Department to address defense manufacturing and production-related issues and have powerfully augmented the DASD(MIBP)'s legacy mission to sustain an environment that ensures the industrial base on which the Department depends is healthy, responsive, and resilient. The DASD(MIBP) is pursuing multiple, concurrent efforts to map and better understand the entire defense industrial base. This family of Sector-by-Sector, Tier-by-Tier (S2T2) reviews and analyses of the industrial base

¹¹ via the FY 2009 reauthorization of the Defense Production Act of 1950; codified in PL 111-67, Section 11.

¹² As prescribed in 10 U.S.C. § 2372.

¹³ This new Manufacturing directorate was established by internal OSD direction and is not required by law.

Establishment of the DASD(MIBP) office created an effective organizational leverage point enabling a stronger focus on the Department's key manufacturing and production needs.

is focused on improving the DoD's understanding of the defense industry, supplying the Department with fact-based analysis, and developing an industrial base data repository to help discern critical and fragile niches of the defense industrial base, better enabling the Department to make well-informed budget and acquisition decisions. Establishing this deep level of understanding and insight provides a strong foundation for the entire Department as it carries out its multiple industrial base support and maintenance roles.

Considering the specific domain of 'the defense manufacturing enterprise,' DASD(MIBP)'s Manufacturing Directorate overseeing the DoD ManTech and DPA Title III programs (and housing the OSD ManTech, DPA Title III and DPAC Support offices) represents a critically important new focal point in the Department. In particular, the Manufacturing Directorate has the organizational visibility and access to policy and investment levers to enable more coherent and integrated approaches to maintaining the full suite of necessary defense manufacturing enterprise capabilities that are reflected in the below graphic. Additional



information on the functions, roles and responsibilities of the DASD(MIBP) office can be found in Annex C.

DOD MANTECH'S ROLE IN THE DEFENSE MANUFACTURING ENVIRONMENT

"ManTech focuses on the timely development, production, and sustainment of defense systems, and thereby enhances our affordability and technological edge in a dynamic, diverse, and evolving threat environment."

- Mr. Brett Lambert, DASD(MIBP)¹⁴

The industrial base is significantly enhanced through ManTech Program-enabled transition of S&T successes. Specifically, ManTech serves as an important mechanism for technology transition, bringing affordable technologies to acquisition program managers through new manufacturing and production processes and systems, thus bridging the gap between discovery and implementation of new capabilities for the warfighter. The Department's S&T priority areas (developed by the Assistant Secretary of Defense for Research and Engineering) also help to shape ManTech investments. Further, the DoD ManTech Program can contribute information to MIBP's on-going S2T2 analyses through its operational perspectives of industrial base activities, as well as its deepening understanding and insights of technology-based supply chain risks. Con-versely, ManTech can be used as an appropriate investment lever for targeted industrial base intervention when necessary to help the Department close newly identified, defense-critical, manufacturing technology related supply chain gaps.

**Defense
Manufacturing Vision:**
A responsive, world-class manufacturing capability to affordably and rapidly meet warfighter needs throughout the defense system life cycle

While ManTech is not statutorily structured to address the entirety of defense industrial base challenges, it is a highly versatile R&D investment program that can serve as a key focal point to bring attention and technological resources to bear on the Department's most pressing requirements for affordable modernization and sustainment. The ManTech Program shares an expansive vision with the broader defense manufacturing enterprise; namely, *a responsive, world-class manufacturing capability to affordably and rapidly meet warfighter needs throughout the defense system life cycle*. Simple yet powerful, this vision captures the overriding imperative to satisfy warfighter requirements across the spectrum of manufacturing activities, while doing so *affordably* and

¹⁴ DoD ManTech Program Brochure, November 2011.

rapidly. Congress has long recognized this essential, enabling role, establishing ManTech in Section 2521 of Title 10, United States Code to:

“...further...national security objectives...through the development and application of advanced manufacturing technologies and processes that will reduce the acquisition and supportability costs of defense weapon systems and reduce manufacturing and repair cycle times across the life cycles of such systems.” (see Annex A for full text)

ManTech Mission:
DoD ManTech anticipates and closes gaps in manufacturing capabilities for affordable, timely, and low-risk development, production, and sustainment of defense systems.

The program's mission, therefore, is multi-faceted and vital; namely, *DoD ManTech anticipates and closes gaps in manufacturing capabilities for affordable, timely, and low-risk development, production, and sustainment of defense systems.* The program looks beyond the normal risk of industry and directs investments at improving the quality, productivity, technology, and practices of businesses and workers providing goods and services to the DoD.

ManTech's role as a crucial link between technology development and industrial application gives the program a unique and vital position within the defense industrial base and broader strategic security environment. By its very nature, the introduction of advanced weapon systems entails the use of new product technologies that provide the performance enhancements that make the new weapon systems desirable. The ability to introduce these performance



enhancements is often limited by the ability to manufacture them at an affordable cost, at an acceptable rate, and with the consistent quality that can be a matter of life and death for the warfighter. Thus, the maturing of manufacturing processes and equipment in parallel with the maturation of the product technology is vital if advanced weapon systems are to be fielded on-time, at cost, and with the desired mission performance capability. Advancement of manufacturing

technology—the central focus of the ManTech Program—is thus essential to the introduction of advanced weapon system capabilities. The ManTech Program's activities not only cross multiple organizational boundaries within the Defense Department but they also span the entire defense industrial base, including prime contractors, subcontractors, suppliers, hardware and software vendors, industry consortia, manufacturing centers of excellence, colleges and universities, and research institutions. The DoD ManTech community also works closely with other federal agencies, representing defense manufacturing policy and building cross-agency coordination for critical manufacturing R&D needs. The ManTech Program serves the Department as a valuable resource, combining the breadth of programmatic and requirement knowledge with deep technical expertise.

ManTech Program Governance and Execution

Section 2521 of Title 10, United States Code, requires the USD(AT&L) to administer the DoD ManTech Program on behalf of the SECDEF. The DoD ManTech Program is administered for the USD(AT&L) by the DASD(MIBP), which exercises OSD-level over-sight. Component ManTech programs are individually executed by the Departments of the Army, Navy, Air Force, the Defense Logistics Agency (DLA) and OSD.¹⁵ These Component programs collaborate and

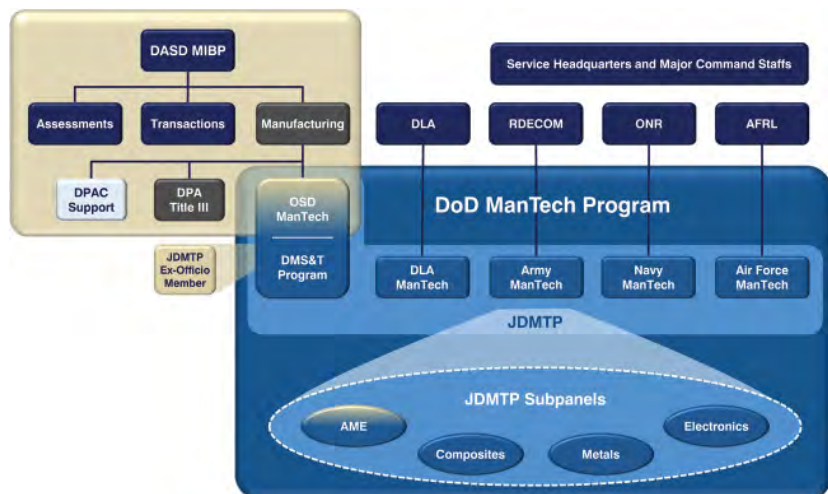


Figure 2. DoD ManTech Program Organization

¹⁵ The OSD ManTech Office in ODASD(MIBP) executes the Defense-wide Manufacturing Science and Technology (DMS&T) Program.

coordinate their efforts through the Joint Defense Manufacturing Technology Panel (JDMTP). The JDMTP organizational structure, codified in law¹⁶, is depicted within Figure 2 and is addressed in more detail in Annex D.

10 U.S.C. § 2521:
“The Secretary may carry out projects under the program through the Secretaries of the military departments and the heads of the Defense Agencies.”

The Principals of the JDMTP are senior technology managers representing the Army, Navy, Air Force, and DLA. OSD is represented as an ex-officio member of the panel to provide the communication link to OSD as well as in the capacity of manager of the DMS&T Program line. Other ex-officio members of the JDMTP include DARPA (see Annex F), NIST, NASA, and DoE. The JDMTP categorizes ManTech investment areas by the technology portfolios of subpanels—the current subpanels are Electronics, Metals, Composites and Advanced Manufacturing Enterprise—enabling Component ManTech programs to maximize opportunities for shared investment in initiatives and strategies with joint application, and to prevent duplication of effort.

Service and DLA ManTech programs comprise the majority of the DoD ManTech investment portfolio and are each overseen and managed within the S&T organizational structures of their associated DoD Component. Additionally, the DASD(MIBP), whose ManTech Office administers the DMS&T Program, is a member of the S&T Executive Committee (EXCOM) comprised of those key organizations in DoD that oversee and coordinate the S&T activities of the Department. Although all Component ManTech programs work in concert toward common goals, each has important focus areas to meet individual Component mission needs.

- The Army ManTech Program is structured around enabling manufacturing improvements of components and subsystems for air, ground, Soldier, and command/communications systems.
- The Navy ManTech Program’s critical goal is to reduce the acquisition cost of current and future platforms, resulting in an affordability investment strategy currently focused on four ship platforms and the F-35 aircraft.
- The Air Force ManTech Program’s near-term efforts include affordability and producibility improvements for advanced turbine engines, stealth, depot efficiencies, space solar cells, and advanced radar.
- The DLA ManTech Program focuses on sustaining the warfighters and their materiel; ongoing efforts support improvements in providing a

¹⁶ 10 U.S.C. 2521(e).

source for non-procurable microcircuits, combat rations, clothing and protective equipment, batteries, forgings, and castings.

- The OSD-managed DMS&T Program takes a broad, overarching view towards closing critical gaps in cross-cutting, military manufacturing enabling technologies that will have a significant impact on multiple services or platforms.

From a joint perspective, the value of understanding these Component mission-driven priorities is not in the seemingly different manufacturing focus areas, but in identification of common manufacturing challenges and technology solutions,

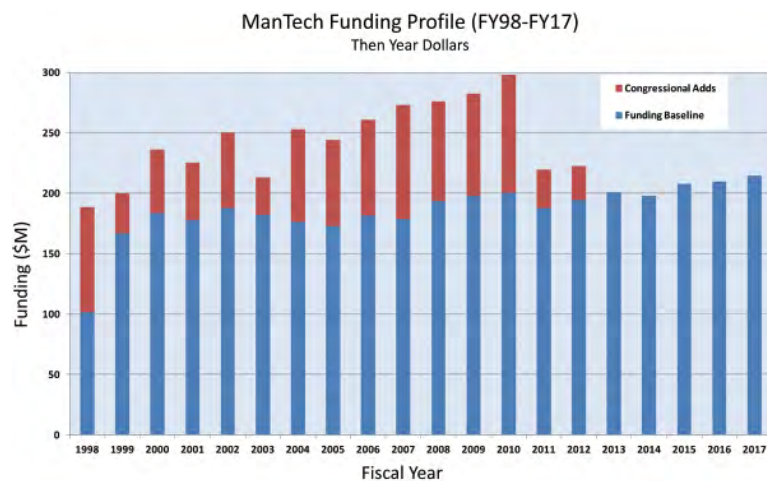


Figure 3. ManTech Program Funding Profile (Then-Year Dollars)

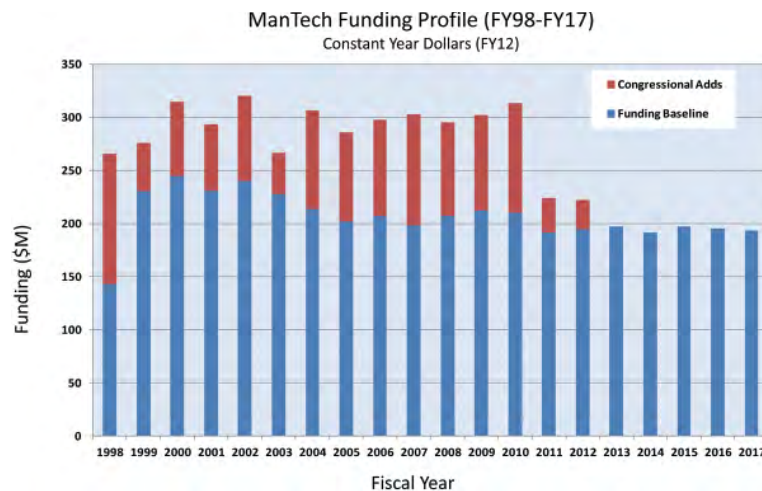


Figure 4. ManTech Program Funding Profile (Constant-Year Dollars)

where investments can be combined or leveraged. This process of determining joint technical pursuits is critical, because program funding flows through and is controlled by Component ManTech programs.

Figures 3 and 4 reflect congressionally appropriated aggregate funding managed by all Components of the DoD ManTech Program over the past 15 years, in both then-year and constant-year (2012) dollars, respectively, plus future ManTech funding as reflected in the FY13 President's Budget request to

Table 1. ManTech Program Funding, by Program Element (Dollars, in Millions)

PROGRAM	FY12 Approved	FY13 PB				
		FY 13	FY 14	FY 15	FY 16	FY 17
OSD DMS&T (PE 0603680D8Z)	46.3	22.0	22.4	22.9	23.6	24.0
Army ManTech (PE 0708045A)	59.3	59.9	60.0	65.2	64.6	66.2
Navy ManTech (PE 0708011N)	54.0	54.9	54.1	52.8	57.0	57.4
AF ManTech (PE 0603680F)	40.1	37.0	36.4	41.4	38.9	41.2
DLA ManTech (PE 0708011S)	22.5	27.0	24.8	25.2	25.5	26.0
TOTAL**	222.2	200.8	197.6	207.5	209.6	214.7

Congress. The figures show a flat trend approaching \$300M up through 2010, followed by a sharp decline in 2011 to approximately \$200M (due primarily to the reduction in congressionally added projects), and continuing at that level across the FYDP.



Table 1 provides the breakout of Military Department, DoD Agency, and OSD ManTech Program budgets for FY12 through FY17 as reflected in the FY 2013 President's Budget submission.

Maintaining stable, predictable, and sufficient investment levels across all program elements is necessary to minimize ManTech Program turbulence and enable meaningful impact to defense system development, acquisition and sustainment needs. The next section presents a framework of strategic thrusts and enabling goals designed to optimally couple these resources within the ManTech portfolio in support of the Department's priorities.

Additional information on the DoD ManTech Program, including its organization and investment processes, can be found in Annex D.

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III. A FRAMEWORK TO MAXIMIZE MISSION EFFECTIVENESS – THE MANTECH PROGRAM’S STRATEGIC THRUSTS AND ENABLING GOALS

“Essentially, the industrial base is part of our force structure and we have to treat it like it is.”

Hon. Frank Kendall, USD(AT&L)¹⁷

Given the enormous span of defense manufacturing and industrial base needs, the DoD ManTech Program must be careful to focus and execute its relatively small investment footprint within the Department for maximum effectiveness. The following four strategic thrusts have been established to unify and guide the joint ManTech enterprise, consistent with the defense manufacturing vision and ManTech Program mission:

The DoD Manufacturing Technology Program is guided by four strategic thrusts.

- Thrust 1: *A Responsive and Balanced Manufacturing Technology Investment Portfolio to Meet DoD Requirements*
- Thrust 2: *Active Support for a Highly Connected and Collaborative Defense Manufacturing Enterprise*
- Thrust 3: *Active Support for a Strong Institutional Focus on Manufacturability and Manufacturing Process Maturity*
- Thrust 4: *Active Support for a Healthy, Sufficient, and Effective Defense Manufacturing Infrastructure and Workforce*

¹⁷ Frank Kendall, “The Acquisition Implications of the DOD Strategic Guidance.” Speech before the Center for Strategic and International Studies, February 6, 2012.

This framework establishes the program’s core focus on ensuring responsiveness and balance across the full portfolio of manufacturing technology investments (Thrust 1), and it couples that focus with the desire to actively and collectively support broader defense manufacturing needs (Thrusts 2, 3, and 4). This approach underscores the importance of program support for these broader needs while recognizing it is beyond the program’s charter and resources to fully satisfy them.

This broad, top-down arrangement of strategic thrusts is vital, given that the ManTech Program, with its cross-cutting nature, impacts or is impacted by almost all defense manufacturing issues facing the Department. Further, a symbiotic relationship exists between the objective of the program-focused Thrust 1, a responsive and balanced portfolio, and the desired outcomes of the enterprise-focused Thrusts 2, 3, and 4, which must be achieved to fully leverage the portfolio results.



Figure 5. The DoD ManTech Program’s Strategic Thrusts

Figure 5 graphically depicts the program’s four strategic thrusts including the unique positioning of its three manufacturing enterprise “support” strategies (Thrusts 2, 3, and 4), which foster active support for broader defense industrial base needs. In fact, each of these four thrusts directly supports the SECDEF’s strategic guidance addressed in Section II. In particular, processing and fabrication breakthroughs enable affordable production for effective modernization; material

and manufacturing investments made concurrently with S&T R&D projects deliver technological advantage to the warfighter quickly; and enterprise level initiatives create more connected and collaborative environments, a stronger focus on manufacturability, and improved manufacturing infrastructure—all of these support the maintenance of a healthier and more resilient industrial base. This collective set of thrusts drives important program activities and the collaboration necessary to meet the statutory requirement to ensure appropriate coordination between the manufacturing technology programs and similar programs undertaken by other departments and agencies of the Federal Government or by the private sector. This increased connectedness and collaboration (further engendered by Thrust 2) enables a strong, enterprise-wide focus on manufacturability and manufacturing process maturity as well as a more unified effort to sustain a sound defense manufacturing infrastructure and workforce, all of which, in turn, serve to magnify the potential influence of ManTech's investment portfolio (Thrust 1) and its impacts on affordability, timely delivery of capability, and a healthy, responsive and resilient industrial base.

The full suite of available policy, outreach, and strategic communications tools should be brought to bear in support of all four strategic thrusts.

Planning to support these four thrusts includes:

- coordination and development of Departmental and Component policies and legislative recommendations;
- partnering activities, both internally within the JDMTP as well as externally across the Federal Government, industry, and academia;
- subject matter expert participation in various initiatives; and
- other outreach and strategic communication efforts.

The following paragraphs define each of the strategic thrusts in more detail and present the ManTech Program's enabling goals supporting each one. These 10 goals provide important operational definition to enable focused action through joint and individual Component initiatives, supporting plans and roadmaps.

Strategic Thrust 1

**A Responsive and Balanced
Manufacturing Technology
Investment Portfolio to Meet
DoD Requirements**

STRATEGIC THRUST 1: A RESPONSIVE AND BALANCED MANUFACTURING TECHNOLOGY INVESTMENT PORTFOLIO TO MEET DOD REQUIREMENTS

This central or “core” thrust of the ManTech Program is focused on two critical ideas: responsiveness and balance (across ManTech’s portfolio). The DoD ManTech Program must be responsive in meeting strategic DoD priorities, delivering advanced manufacturing processes quickly, and enabling affordable modernization programs and transition of emerging technologies, all of which help maintain the warfighter’s technological edge. Advanced manufacturing processes are primarily responsible for increasing system performance while accommodating decreased size, weight, and power requirements. As such, processing and fabrication R&D investments, properly balanced across the metals, composites, and electronics technology sectors, will continue to be the primary focus of the portfolio. However, these should also be balanced against a growing family of enterprise level manufacturing R&D investments that can create powerful, game-changing advances for the Department.

The pursuit of this strategic thrust encompasses three broad activities: engagement with the wider manufacturing enterprise, analysis and prioritization of investments, and effective execution of the portfolio. The desired outcome of a responsive portfolio requires a full understanding of the warfighter needs and leadership priorities combined with business practices to quickly exploit opportunities through joint technical investments. Characteristics of a balanced portfolio are more complex. The attribute of “balance” is not to be confused with seeking equality, but rather describes an appropriate proportion based upon objectives. Characteristics that may be considered for balancing include risk level (high versus low risk), time horizon (near versus far term), technical sector (investment or activity distribution among Metals, Composites, Electronics, and AME), and strategic or organizational level (centralized or joint requirements versus Component mission needs). Care should be taken to adequately analyze the existing portfolio content and trends in light of significant shaping factors from the Department and Administration, other federal departments/agencies, and the private sector.

Thrust 1 represents the program's core business focus and maps most directly to the ManTech mission.

This thrust represents the core business focus of the DoD ManTech Program, mapping most directly to the program's mission statement and greatly influencing the program's priorities. This strategic thrust assumes a certain primacy, shaping the precedence for and investment in all ManTech Program needs, including those addressed in Thrusts 2, 3, and 4. It comprises the vast majority of program activity, from requirements determination, to prioritization of ManTech proposals and projects, to ManTech project management and execution.

Strategic Thrust 1 is supported by three enabling goals that are focused, respectively, on continuous, enterprise-wide engagement (Goal 1.1), portfolio analysis and prioritization (Goal 1.2), and delivery of manufacturing technology solutions (Goal 1.3). These are reflected in the below graphic and are each discussed in the following paragraphs.



Enabling Goal 1.1: Enterprise-Wide Engagement to Develop Manufacturing Technology Priorities

Goal 1.1 calls for active, broad engagement, underscoring the importance of ManTech maintaining and exercising continuous connections across the extended defense manufacturing enterprise.

This enabling goal refers to a sustained, bi-directional engagement with government, academic and industry organizations across the U.S. manufacturing enterprise, with a focus on defense manufacturing requirements. This engagement should occur at multiple organizational levels and throughout the annual planning cycle. The desired outcome is a broad understanding of manufacturing technology needs, considering the technical, economic, policy, budget and competition aspects. These shaping factors will provide greater precedence to joint manufacturing technology needs, commercial leverage, urgent warfighter requirements, economic return on investment, and diminishing domestic supply chains. Capturing this information requires seeking out

stakeholders from DoD and federal R&D organizations, industry associations, and universities.

The engagement activities within this goal should occur regularly during JDMTP Principals meetings, technical subpanel meetings, industry and academic conferences, program site visits, interagency committee meetings, and regional workforce development events. Pursuing this goal helps lay the groundwork to enable the systemic capture and harmonization of these shaping factors to develop investment opportunities with high leveraging value and external support. The knowledge gained during these engagements will feed directly into the analysis, prioritization and investment decisions made by the JDMTP, Component programs and OSD in support of Goal 1.2. Examples of impactful joint programs built upon active, enterprise-wide engagement include the development of MEMS-based IMUs, the chip-scale atomic clock, and the DoD-led initiative to establish a national pilot institute focused on additive manufacturing.

Enabling Goal 1.2: Rigorous Internal ManTech Analysis and Prioritization of the Portfolio

Goal 1.2—rigorous portfolio analysis and prioritization—is the hard work necessary to address the multiple aspects of portfolio “balance” to best meet DoD’s advanced manufacturing needs.

This goal is focused on the ManTech Program’s internal processes and practices that help to synthesize the shaping influences identified through enterprise-wide engagement activities (Goal 1.1), enabling effective investment portfolio analysis, prioritization and balance. Pursuing this goal creates opportunities to more fully and equitably address the family of critical defense manufacturing and industrial base needs across the technology spectrum.

This effective “balancing” of the ManTech portfolio is a challenging but important undertaking. The mission needs and priorities of each Component are the primary drivers shaping that Component’s ManTech investments. With that basis established, the JDMTP also has a key statutory responsibility to collectively identify requirements, conduct joint planning, and develop joint ManTech Program strategies, requiring that the Components actively collaborate to define joint priorities. The combination of these perspectives yields the greatest synergy, whereby Component priorities can help inform joint ManTech investments, and vice versa. This goal therefore emphasizes the optimal blending of these two (i.e., Component and joint) perspectives through increased collaboration and use of common planning and decision

support tools where appropriate. The JDMTP can lead these efforts through annual joint portfolio reviews and analyses that, over time, will lead to improved visibility, understanding and insight into the portfolios themselves, including better awareness of trends, risk levels, and return on investment (ROI). This in turn drives smarter portfolio prioritization and better balance across the ManTech enterprise, ultimately contributing to improved industrial base health, responsiveness and resilience.

In support of this goal, a current JDMTP initiative entails the technology subpanels refining a list of the most significant joint technology pursuit areas within their respective domains. These recommended technical pursuits represent those joint manufacturing R&D priorities that will enable the scaled-up manufacture of the Department's highest value, leading edge defense systems and capabilities. Examples of the current investment priorities by technical subpanel are provided in table 2, below.

Table 2. Manufacturing Technology Priorities

Composites Processing and Fabrication Technology Area
Key investment areas for composites include structures focused on the DoD capabilities for high temperature, light weight, marine durable and specialty applications such as conformal radomes as well as rapid / flexible response-enabling manufacturing technologies.
Electronics Processing and Fabrication Technology Area
Key investment areas for electronics include wide bandgap and silicon carbide (SiC) devices, lithium ion (Li-Ion) batteries, advanced packaging and fabrication technologies, infrared sensors and lasers and their associated components, and micro and flexible display technologies.
Metals Processing and Fabrication Technology Area
Key investment areas for metals include material processing, castings and forging, and joining. Critical application areas include ballistic armor, affordable vehicle components, and lightweight, thin-walled structures. Additional priorities include intelligent machining, titanium powder metals, and lightweight alloy initiatives.
Advanced Manufacturing Enterprise Technology Area
Key investment areas for AME include manufacturability tools to enable better designs, implementation of improved 3D technical data packages, intelligent manufacturing methods, supply network modeling and integration, and product/process data interoperability.

See Annexes D and E for additional discussions of current and emerging initiatives within each of the above four technical areas.

*Goal 1.3 is about
delivering to the
customer.*

Enabling Goal 1.3: Timely and Effective Delivery of Defense-Essential Manufacturing Technology Solutions

Achieving this goal relies upon sound operational management and technical execution of the core ManTech Program, guided by the analysis and prioritization activities of Goal 1.2, and consistent with JDMTP and Component ManTech program policies and procedures. Manufacturing technology portfolios should be effectively developed and managed by the program Components thorough analyses of defense system affordability drivers and a keen focus on DoD customer priorities. A high degree of joint-service planning within each portfolio increases leverage across Military Departments and DoD Agencies while preserving Component priorities. One example is the joint family of OSD, Navy and Air Force ManTech programs recently recognized by Vice Admiral David Venlet for their outstanding support to the Joint Strike Fighter (JSF) program that he oversees as Joint Program Executive Officer. Their partnership helped yield four affordable and producible technologies that are projected to reduce F-35 program costs by \$1.1 billion over 30 years of production.

Key activities within this goal include technical and program management best practices which enhance the execution of the portfolio and increase the successful transition of projects into defense acquisition or sustainment programs. Also inherent to this goal is the delivery of solutions that follow defense priorities crossing technical boundaries, such as “sustainable manufacturing,” focused on meeting energy security objectives by reducing energy demands, using alternative energy sources, and meeting future environmental compliance policies.

Strategic Thrust 2

Active Support for

**A Highly Connected
and Collaborative
Defense
Manufacturing
Enterprise**

STRATEGIC THRUST 2: ACTIVE SUPPORT FOR A HIGHLY CONNECTED AND COLLABORATIVE DEFENSE MANUFACTURING ENTERPRISE

This is the first of three DoD ManTech Program strategic thrusts applying to the broader defense manufacturing base, or “enterprise.” 21st century defense manufacturing relies on a networked, collaborative and increasingly global supply base, with capabilities that can be linked within and among the nodes to respond rapidly to continually changing defense needs. The cost and schedule

of defense systems are driven primarily by activities that are “above the factory floor”, i.e., in enterprise level processes, business practices and interactions with suppliers and with the government customer. The Department’s ManTech Program has a strategic interest in the development and implementation of such enterprise capabilities. Advanced manufacturing enterprise (AME) projects, implemented in concert with NIST and industry partners, enable a healthy and responsive industrial base through advanced, interoperable tech data standards working across traditional product and process domains. A highly connected and collaborative industrial base provides great strategic advantage for the DoD, speeding technology transition and generating shared infrastructure. As suggested in the thrust’s description, it couples a structural component (“highly connected”) with a dynamic or interactive and information sharing component (“collaborative”). Both components of this thrust are embodied in the following two enabling goals as discussed next.



Goal 2.1 encompasses the research, development and implementation of capabilities of model based enterprises, network centric manufacturing, modeling & simulation, and best commercial practices.

Enabling Goal 2.1: Innovative, Enterprise-Level ManTech Initiatives Enabling Collaborative and Network Centric Manufacturing

This goal encompasses the research, development, and implementation of capabilities which allow for a highly interactive manufacturing environment among the multiple entities in system development, production and sustainment. Example initiatives that fit within this goal include model-based enterprise (MBE) and network centric manufacturing activities, development of government and industry standards and procedures to fully exploit the use of digital 3D technical data, collaborative modeling and simulation capability development, and the application of best commercial practices within defense

manufacturing. Innovative approaches to collaboration should occur along each phase of a product's life cycle, and between traditionally separate entities, such as the program executive office (PEO), prime contractors, original equipment manufacturers (OEMs), and multiple suppliers. ManTech Program support for this goal can include elements of technical development, proof of concept experiments, and pilot programs.

Highly networked and collaborative manufacturing capabilities provide the structure required for a synchronized and secure defense manufacturing enterprise, with real-time visibility into both product lifecycle design data and manufacturing and support capabilities. Model-based enterprise activities provide the collaborative design environment between engineering and design, production and test, and the manufacturing supply chain. The objectives of MBE include a highly integrated "design for manufacturability" capability, increased fidelity cost modeling, pre-production test and validation, and first article quality. The promise of MBE is the ability to cycle through multiple design, model, and test cycles before producing the final system with confidence.

A final, but critical approach to a highly connected and collaborative defense manufacturing enterprise is the adoption and integration of commercial manufacturing practices where applicable. This allows for the greatest leverage of existing production capabilities across industry and breaks down barriers to an affordable, responsive defense manufacturing supply chain. Enabling military products to be manufactured within required specifications using the same processes or even on the same production lines as commercial products can significantly expand the base of qualified domestic suppliers, reduce product delivery times, and reduce unit production costs.

Goals 2.2: Robust deployment of ManTech projects may transition results well beyond the primary transition target(s) into additional systems and transform an innovative, first-use manufacturing capability into a viable industry.

Enabling Goal 2.2: Robust Deployment of ManTech Program Results Throughout the Defense Industrial Base

This goal represents the search for expanded transition paths to further deploy the results of technology projects conducted by the ManTech Component programs. A focus on aggressive deployment of manufacturing technologies across the Military Departments, participating Defense Agencies and industry can significantly increase the leverage of limited ManTech investment resources, amplifying the program's benefits to the industrial base. This requires strong leadership emphasis and intense coordination between the Component

ManTech programs, the executing contractor, and the initial transition program to ensure that the work is described accurately, the maturity of processes are captured, and that intellectual property is protected. In the best case, robust deployment will transition results well beyond the primary transition target into additional systems and may transform an innovative, first-use manufacturing capability into a viable industry.

When considering broader technology transitions throughout the defense industrial base, one of the primary modes of information dissemination is the use of web-based capabilities, including a continually refreshed DoD ManTech Program website, indexed by technology sector and containing best-practice management and technical processes and practices. Additionally, the annual Defense Manufacturing Conference should continue to be exploited as a highly potent forum for dissemination of ManTech results across both government and private sectors. Other effective technology dissemination and deployment outlets include industry association conferences, trade group meetings, academic gatherings, and annual Service or Agency acquisition conferences.

In summary, ManTech Program leadership and the broader ManTech and defense manufacturing communities should continually and actively look beyond initial technology transition targets and seek opportunities for subsequent transition of program results and provide stakeholders with an adequately captured knowledge base.



STRATEGIC THRUST 3: ACTIVE SUPPORT FOR A STRONG INSTITUTIONAL FOCUS ON MANUFACTURABILITY AND MANUFACTURING PROCESS MATURITY

This thrust points to the strategic need for a pervasive culture that embodies a cradle-to-grave focus, across DoD and industry, that persistently considers weapon system manufacturability and aggressively resolves associated production and sustainment issues over the acquisition life cycle. This need is fully achieved only when the Defense Acquisition System properly considers manufacturability across all research, development, and acquisition phases, requiring the adoption of best practices as well as deployment of effective policy guidance. This in turn maximizes opportunities to positively influence weapon

system cost, schedule, and performance through manufacturing reviews appropriate for each phase of research, development and acquisition. History shows that if left unchecked and unmanaged, emphasis on manufacturability and producibility tends to “slip to the right” in a system’s development timeline, reducing opportunities to positively influence cost, schedule, and performance. Accordingly, Strategic Thrust 3 drives a system-wide focus on manufacturing across all research, development and acquisition phases while ensuring that the central focus is sufficiently prior to system production for greatest benefit. This is encouraged through several enabling goals focused on support for improvements to acquisition policy and processes, integration of design for manufacturability into the DoD systems engineering process, and structured analyses of cost and affordability drivers related to manufacturing, as reflected below



Enabling Goal 3.1: Effective Policies and Practices to Assess and Improve Manufacturing Readiness

Goal 3.1 involves the development and maintenance of a body of knowledge sufficient to support the implementation of manufacturing readiness as a management criterion.

This goal encompasses the continued development and maintenance of a body of knowledge sufficient to support the implementation of manufacturing readiness as a risk management criterion within the Defense Acquisition System. Manufacturing risks are often critical to an acquisition program. If not managed well, such risks can lead to significant cost increases, schedule slippage, and degraded system quality and performance. Effective manufacturing risk assessments, sustained by a strong institutional focus on manufacturing readiness, provide a sound basis for program managers to take risk reduction actions to avoid these impacts. Full implementation requires a validated scale of Manufacturing Readiness Levels (MRLs), an assessment process, and subject

matter expertise to assist in performing manufacturing readiness assessments, each of which has been defined and coordinated between government organizations that implemented MRLs and industry through the efforts of the JDMTP. These processes and tools should be integrated into systems engineering processes through effective acquisition policy. Specific initiatives supporting this goal include:

- oversight of a joint DoD and industry working group to maintain and refine the manufacturing readiness body of knowledge, in partnership with the office of the DASD for Systems Engineering; and
- partnering with Defense Acquisition University (DAU) to provide effective MRL training for the S&T and Acquisition workforce.

Enabling Goal 3.2: Full Integration of “Design for Manufacturability” Across the Defense Acquisition Cycle

Fully integrating design for manufacturability (Goal 3.2) requires partnership with the technical community in combination with standardized practices appropriate for DoD and industry.

This goal embodies the overarching objective of a strong institutional focus on “manufacturability” across the defense acquisition framework, which directly supports the health of the defense industrial base. Inadvertently designed-in producibility issues drive significant “hidden factory” inefficiencies across the manufacturing enterprise that directly and indirectly impact life cycle costs, while at the same time hinder the effectiveness of the defense industrial base. The full integration of design for manufacturability (DfM) requires partnership with the government and industry technical community in combination with standardized practices appropriate for DoD and industry. The ManTech community should continue partnering with the DoD systems engineering community to document, promulgate and train practitioners in implementing best practices for DfM, including systematically considering manufacturability and producibility throughout materiel and weapon system life cycles, instituting modeling and simulation advancements, etc. The ManTech and systems engineering communities should strive for consensus on methods and policies to best integrate DfM considerations into technical reviews throughout the entire technology development cycle. An effective role for ManTech under this goal is to support the assembly of a DfM tool-set applicable to early development phases, extending commonly available toolsets for detailed design.

Enabling Goal 3.3: Structured Analysis of Manufacturing Cost Drivers for ManTech Emphasis, in Partnership with PEOs and Industry

Identification of highest-leverage ManTech investment opportunities (Goal 3.3) is critical both for project prioritization and broad transition of results across multiple systems.

This goal addresses the need to understand the highest priority opportunities for targeted manufacturing cost reduction, both within major defense programs and across multiple product lines throughout system lifecycles. This activity is highly aligned with the USD(AT&L)'s Better Buying Power initiative and requires collaboration with PEOs and industry. Since parametric cost estimates used by most systems under development do not offer manufacturing process trade-offs, should-cost estimates should be analyzed for specific manufacturing process improvements that can have a substantial impact.

An element of this goal is to evaluate multiple weapon systems for systematic manufacturing cost drivers, which can identify key ManTech investment opportunities. A case in point is electronic components within antenna arrays. These arrays are used in several systems across Military Departments and Defense Agencies, and each array contains up to 5,000 similar electronics components. While a single system or ManTech Component program may not be able to fund an improved manufacturing process, such arrays meet the cost driver criteria for a ManTech investment. Identification of these types of opportunities is critical both for project prioritization and broad transition of results across multiple systems.

Strategic Thrust 4

Active Support for

**A Healthy, Sufficient,
and Effective Defense
Manufacturing
Infrastructure and
Workforce**

STRATEGIC THRUST 4: ACTIVE SUPPORT FOR A HEALTHY, SUFFICIENT, AND EFFECTIVE DEFENSE MANUFACTURING INFRASTRUCTURE AND WORKFORCE

While the DoD ManTech Program is not structured to be solely responsible for meeting workforce or infrastructure requirements, ManTech projects can provide leverage to support these broader industrial base needs, in concert with other statutory programs such as DPA Title III and the Acquisition Workforce Fund. Strategic Thrust 4 is a vital enabler for a highly effective defense manufacturing enterprise, and DoD policy requires that the ManTech

Program promote the key attributes supporting these needs.¹⁸ Doing so is in ManTech's best interests and fits within the Department's strategic imperative calling for a resilient defense industrial base. A healthy, sufficient, and effective defense manufacturing infrastructure, integrated with a flexible, innovative and capable defense manufacturing workforce, underpins the ManTech Program's mission effectiveness and broader industrial preparedness in multiple ways. Support for this thrust area is addressed in two separate enabling goals: (1) addressing ManTech promotion of investment in new plants and equipment and their supporting systems for industrial innovation and readiness, and (2) ManTech support for a highly capable, well trained and educated manufacturing workforce.



Enabling Goal 4.1: Active Promotion of Investment and Innovation in Manufacturing Infrastructure and Management Systems

Goal 4.1 recognizes ManTech's role to actively promote broad, government-industry partnership and investment supporting industrial preparedness.

The objective of this goal is to actively promote sufficient government and industry investment in new plants and equipment and in manufacturing management innovations, all in support of industrial preparedness. Sustained achievement of this goal requires both reducing the cost and risk of advancing and applying new and improved manufacturing technology and engaging with programs chartered to transition or implement production technologies after ManTech investments (such as DPA Title III for increased production capability).

¹⁸ Specifically, DODD 4200.15 requires investments in ManTech to "promote capital investment and industrial innovation in new plants and equipment by reducing the cost and risk of advancing and applying new and improved manufacturing technology" and "sustain and enhance the skills and capabilities of the manufacturing work force, and promote high levels of worker education and training."

A critical enabler for this goal is the successful transition of ManTech project results across multiple platforms, which in turn serves as a catalyst for capital investment. The cost and risk of manufacturing technology transition is reduced through implementation of manufacturing readiness as a management criterion, along with the use of technology transition plans. A technology transition plan documents the customer needs and technical metrics and establishes a threshold value for all key parameters. ManTech should investigate appropriate uses of incentive mechanisms, Department policies, and statutory changes, in concert with ODASD(MIBP).

Enabling Goal 4.2: Effective ManTech Contribution to a Highly Capable, Well Educated Defense Manufacturing Workforce

Enabling a highly trained workforce (Goal 4.2) requires coordination and support for multiple tiers of competencies, within both the organic and non-organic workforce.

The advanced manufacturing enterprise depends on a highly interactive mix of systems, processes, and manufacturing technologies, requiring a highly skilled and competent workforce. This workforce must embrace continuous, lifelong learning and pursue skills, increasingly standardized, validated, and certified portable, to be effective. Academia should be engaged at several levels in support, including at the university level to focus on manufacturing research and offering advanced manufacturing-relevant degrees; at the community college level to provide advanced skills for both the current and future manufacturing workforce; and across primary and secondary schools to develop early understanding of, and interest in, manufacturing careers. For the connected and collaborative manufacturing environment to be effective, a new set of workforce skills will need to be proliferated, demonstrated, and deployed. Net-centric manufacturing, model-based enterprise and manufacturing readiness principles cannot be effectively applied without broad-minded, technically competent employees, on the shop floor and throughout all manufacturing and engineering organizations.

The Institute for Defense Analyses and the Society for Manufacturing Engineers have populated the upper tiers of a Department of Labor advanced manufacturing competency model¹⁹ to define a nine-tiered aerospace and defense manufacturing competency model²⁰. Competencies in this new model encompass the manufacturing community's interface with science

19 Advanced Manufacturing Competency Model, Employment and Training Administration, United States Department of Labor, April 2010, <http://www.careeronestop.org/competencymodel/pyramid.aspx?hg=Y>

20 Institute for Defense Analyses Paper P-4927, pending.

and technology, research, design, development, production, and sustainment consistent with the MRL framework. ManTech has contributed to the development of several tiers within this model and should continue to promote awareness and encourage pilot applications.

This goal has several aspects, which can be aligned primarily with specific sectors of the defense manufacturing workforce:

- Organic defense manufacturing workforce: Coordination with DoD human capital management organizations, with the declared objective to revitalize organic manufacturing expertise. Partner with DAU to provide updated PQM (Production / Quality / Manufacturing) workforce qualifications and continuous training topics. Active support for Service/Agency workforce management initiatives.
- Knowledge Management (KM) systems: Support for effective use of KM systems for capture and dissemination of manufacturing skills expertise in defense-essential domains.
- Non-organic/national defense manufacturing workforce: Define industry-sector competencies throughout the manufacturing workforce which enable the advanced manufacturing enterprise. Seek active and enduring DoD support for federal, state, industry and academic initiatives to create and sustain a world-class and sufficiently sized national defense manufacturing workforce. Participation in STEM (Science, Technology, Engineering, and Mathematics) related initiatives to attract and retain manufacturing-related expertise. Specific collaboration with federal and state governments, industry, and academia is necessary.

SUMMARY

In summary, the DoD ManTech strategic framework contains four thrusts and ten enabling goals and features the unique positioning of a core “balanced and responsive portfolio” strategy (Thrust 1) along with three manufacturing enterprise “support” strategies (Thrusts 2, 3, and 4) which extend ManTech's traditional boundaries to drive appropriate ManTech support for broader defense industrial base needs. This collective set of strategies ensures the necessary levels of knowledge, planning and collaboration to meet the statutory purposes of the DoD ManTech Program contained in 10 U.S.C. § 2521, as shown in Table 3.

Table 3. Strategic Framework Support for ManTech's Statutory Requirements

<div> <div>Secondary Relationship</div> <div>Primary Relationship</div> </div>		DoD Manufacturing Technology Strategy									
		Thrust 1 Responsive and Balanced Portfolio			Thrust 2 Connected & Collaborative Enterprise		Thrust 3 Moving Manufacturing Left			Thrust 4 Infrastructure & Workforce	
		Goal 1.1	Goal 1.2	Goal 1.3	Goal 2.1	Goal 2.2	Goal 3.1	Goal 3.2	Goal 3.3	Goal 4.1	Goal 4.2
10 USC 2521 Stated Purposes	(1) Provide centralized guidance and direction to Military Departments & Defense Agencies on all ManTech matters. . .										
	(2) Direct the development and implementation of plans, programs, projects, activities promoting ManTech. . .										
	(3) Improve the manufacturing quality, productivity, technology, and practices of businesses and workers. . .										
	(4) Focus DoD support for the development and application of adv. manufacturing technologies & processes. . .										
	(5) Disseminate information concerning improved manufacturing concepts. . .										
	(6) Sustain and enhance the skills and capabilities of the manufacturing work force. . .										
	(7) Promote high-performance work systems; high levels of worker education and training. . .										
	(8) Ensure appropriate coordination between the manufacturing technology and industrial preparedness programs. . .										

These strategic thrusts also exploit the Administration's increasing attention to advanced manufacturing through appropriate coordination between the manufacturing technology programs and similar efforts undertaken by other departments and agencies of the Federal Government or by the private sector. The increased connectedness and collaboration enables a strong, enterprise-wide focus on manufacturability and manufacturing process maturity as well as a more unified effort to sustain a sound defense manufacturing infrastructure and workforce. This amplifies the potential influence of ManTech's investment portfolio and its impacts on the timely delivery of affordable capability in support of a healthy, more responsive and resilient defense industrial base.



IV. MECHANISMS TO SUPPORT PROGRESS AND ASSESS PROGRAM EFFECTIVENESS

This section addresses mechanisms to support implementation of the DoD ManTech Program strategy and mission, as well as mechanisms to assess the program's effectiveness in meeting the associated objectives.

SUPPORTING (AND DRIVING) PROGRESS

The mechanisms representing the “implementation layer” of the strategy that helps to transform strategic intent into demonstrable and productive action include those of the Component ManTech programs as well as the joint planning processes of the JDMTP.

Component Program Plans and Processes

At the DoD Component execution level, each Military Department and participating DoD Agency develops its ManTech investment plans based on respective strategies and the needs of current and future acquisition and sustainment programs. As an input to each Component's investment planning, Component programs consider the ManTech strategic framework to ensure good linkage with the thrusts and goals of this plan. Resources are allocated and reviewed in the PPBES process and are reflected in the R-1 through R-4 exhibits submitted

to Congress as part of the annual budget justification materials that support the President's Budget.

The Army's Research Development and Engineering Command (RDECOM) has developed the *Army Research, Development and Engineering Command Strategic Plan 2012-2019*. The investment strategy for the Army ManTech Program is to address relevant requirements to maximize technology transition. Annual investment topics are identified by stakeholders and proposals addressing these topics are submitted through the S&T Organizations to RDECOM.

Navy ManTech has adopted an affordability investment strategy and is currently focused on affordability improvements for four major shipbuilding acquisition platforms: DDG Family (DDG 1000 and DDG 51), CVN 78 Class Carrier, Littoral Combat Ship (LCS), and VIRGINIA Class Submarine (VCS). Additionally, Navy ManTech has added a secondary affordability focus for the Joint Strike Fighter (JSF).

The Air Force issued its *Air Force Manufacturing Technology Program Vision in 2010*.²¹ Air Force ManTech's vision of "attaining next-generation agile manufacturing" reflects a studied review of stakeholder needs and Air Force priorities, coupled with a growing national consensus that an aggressive and transformative manufacturing approach is necessary to meet critical Air Force capabilities.

DLA ManTech is an investment portfolio focused on strengthening the DLA industrial base for six critical DLA supply chains: aviation, clothing and textiles, construction and equipment, maritime, land, and subsistence. DLA publishes a longer horizon strategic plan that is supplemented annually with the DLA Director's Strategic Guidance. DLA ManTech project funding is allocated based on the overall ManTech Strategic Plan, DLA Strategic Plan, DLA Director's Strategic Guidance, and the needs of the DLA supply chains.

The Defense-Wide Manufacturing Science and Technology (DMS&T) Program satisfies an essential need within the DoD manufacturing enterprise, attacking cross cutting, multi-service manufacturing gaps and developing material

21 "The Air Force Manufacturing Technology Program Vision," Air Force ManTech, September, 2010.

processing and fabrication solutions in parallel with associated technology development efforts. As such, the DMS&T program is a vital mechanism that serves to drive meaningful progress in support of the joint ManTech strategy.

Annex E provides a more in-depth discussion of the Component ManTech programs and investment priorities.

Joint Planning and Processes

Complementing Component ManTech program processes with joint ManTech Program planning amplifies the DoD ManTech Program's value to the Department. ManTech's joint planning function is founded in Section 2521 of 10 U.S.C., which identifies the following essential purposes of the JDMTP:

- Identify and integrate requirements
- Conduct joint planning
- Develop joint strategies

Joint pursuit areas represent a real power of the JDMTP and its execution of the strategic plan.

The identification of joint pursuit areas and the actions to address them represent a real power of the JDMTP and its tactical approach to executing the strategic plan. As part of this process, identified joint pursuit areas are evaluated based upon the Department's priorities and the ability to leverage other programs, capabilities and resources. Areas identified and supported by the JDMTP can be either technical or non-technical (e.g., policy-based). Pathways to address them can take various forms and represent living supplements to this strategic plan, updated as needed to remain relevant and effective.

Annex D details the JDMTP's structure and its joint planning processes.

ASSESSING PROGRAM EFFECTIVENESS

Fundamentally, the effectiveness of the DoD ManTech Program should be assessed or measured against two benchmarks: (1) the statutory requirements of the program (10 U.S.C. § 2521), and (2) the strategic thrusts and enabling goals of this joint program strategy. 10 U.S.C. § 2521 provides for a multi-layered framework of governance, and the existing mechanisms for assessing effectiveness are comprised of the following:

Assessment Mechanisms exist at three governance levels:

- *Component / execution level*
- *JDMTP portfolio coordination level*
- *OSD oversight level*

- The Component/execution level, by each Military Department, participating Defense Agency and OSD
- The joint portfolio coordination level, by the JDMTP and its subpanels
- The policy and oversight level, by the Office of the DASD(MIBP)

Each organizational layer in the governance structure includes assessment activities closely aligned with the annual planning, management and execution cycles of the ManTech Program. In the paragraphs that follow, assessment and reporting mechanisms that leverage existing activities within each layer of the governance structure are addressed.

Assessment Mechanisms at the Project Execution Level via DoD Components

Component-level internal reviews of ManTech projects are conducted at various schedule frequencies and levels of intensity as determined by the executing Component (i.e., Military Department, DoD Agency or OSD DMS&T Program Manager). The assessment tools managed by these organizations are robust to ensure that:

- each project is planned with specific cost, schedule, performance and technology transition objectives;
- each project has milestones for in-progress reviews by the government program manager to assess progress toward the project objectives;
- each project manager constructs and maintains a transition plan, which contains specific details on manufacturing needs, interim and final customer(s), transition schedule, and transition metrics; and
- each project has effective coordination between the ManTech project team and the primary transition target(s) (Acquisition PM/PEO, depot, logistics center, shipyard, company, or industry sector).

While the Component ManTech programs apply tailored formats, schedules and review team structures to their project assessments, each assessment should provide an effective evaluation of progress towards meeting technology transition and other key investment objectives. Project execution reviews are conducted at least annually against metrics, technical milestones and transition plans, with other reviews occurring more frequently as needed to sufficiently monitor program management criteria. Descriptions of each Component's review processes are contained in Annex E.

Assessment tools managed by the program Component activities are robust.

Assessment Mechanisms at the JDMTP Portfolio Coordination Level

Portfolio coordination activities occur within the JDMTP, primarily within the joint-service, technical subpanel level. Each of the JDMTP's technical subpanels performs an annual portfolio review under a set of coordinated rules set forth by the JDMTP. The portfolio review process is described in detail in Annex D. The review provides a peer-review assessment of each current ManTech project within each portfolio, using the following five criteria:

- Overall needs and benefits
- Technical metrics
- Progress
- Technology transition
- Leveraging

Portfolio reviews by the JDMTP's technical subpanels represent the heart of the DoD ManTech Program's joint technical assessment function.

The portfolio reviews include a strong focus on leverage and transition objectives which provide the widest possible applications across Component programs. Portfolio reviews feature participation by technical experts from each DoD Component as well as from industry, R&D labs, and some acquisition programs. The subpanel review provides project feedback to the principal investigator, project manager and executing Components to assist in improving the project.

Additionally, the status of each overall portfolio is described through top level measures such as average portfolio rating in comparison to previous years, distribution of projects among technical taxonomy areas, average project size, funding leverage from outside ManTech, and project distribution among DoD Components. The subpanels also provide to the JDMTP the recommended pursuit areas. The current pursuit areas are addressed in Annex D. These measures provide the JDMTP Principals with a top-level assessment of both the current health and make up of each portfolio as well as the trends within the technology taxonomy distribution.²²

Finally, the JDMTP has an annual cycle of coordination events, such as the semi-annual spring and fall "All-Hands" meetings. These events feature status

²² The JDMTP recently established a working group to study and make recommendations regarding subpanel portfolio review processes and metrics. This working group has recommended an annual assessment process that includes a minimum set of joint portfolio review criteria. This is under review by the JDMTP.

reports from Service and Agency Principals, technical subpanels and ad-hoc working groups. The joint-service working groups were formed to focus narrowly on specific objectives, such as manufacturing readiness, warfighter relevance, power and energy, RF modules, and lead-free electronics.

The JDMTP also provides logistics support for the annual Defense Manufacturing Conference (an industry sponsored event), with one Military Department (on a rotating basis) acting as “lead” for conference support in terms of recruiting DoD speakers, setting agenda topics, and communications. The conference is the only DoD-focused manufacturing conference and draws roughly 1,000 government and industry attendees every December. The conference represents an effective mechanism for dissemination of program results and assessment of transition and implementation across the industrial base.

Assessment Mechanisms at the OSD/Oversight Level

OSD has primary responsibility to assess strategic, enterprise-level program performance and inform senior Department-level decision makers.

The OSD Manufacturing Technology Office is located within the Manufacturing Directorate of the Office of the DASD(MIBP) and has primary responsibility to assess strategic, enterprise-level program performance and inform senior Department-level decision makers, including outreach to partner communities and engagement with industry. The OSD ManTech Director informs the DASD(MIBP) on the health of the program, including the status of any policy directive initiatives and training programs (for example, manufacturing readiness assessments). The director also has responsibility for preparing and submitting reports as required by Congress or statute, broadly representing the state or health of the DoD ManTech Program, including implementation effectiveness, industrial base benefits, and the Department’s future investment guidance.

OSD further leverages oversight of the ManTech Program via the processes of the executing Components and the JDMTP, and also by conducting outreach activities and maintaining liaison with communities connected to ManTech. These communities include the warfighter and combatant commands, acquisition program offices, research laboratories, academia, industry associations and consortia, and other DoD organizations such as the Office of the Assistant Secretary of Defense for Research and Engineering (through, for example, the ASD(R&E)’s Systems Engineering Office or the Defense Advanced Research Projects Agency (DARPA), an ex-officio member of the JDMTP). Additionally, the DASD(MIBP) is a member of the S&T Executive Committee (S&T EXCOM)

and its supporting Deputies Council. Active outreach and engagement via these activities provides dual benefits for the program; that is, robust engagement with the customer base to capture needs and assess program effectiveness, as well as strategic communication of ManTech Program accomplishments, benefits and overall value to the Department. In particular, engagement with industry provides feedback on ManTech Program management, planning and execution activities—critical to driving full and effective technology transition, as industry often represents the final decision gate for implementation.

Program Assessment Responsibilities, by Enabling Goal and Governance Level

Table 4 provides a summary analysis of organizational roles and responsibilities for each of the enabling goals. As part of their execution, coordination, or oversight roles, each organization employs appropriate assessment mechanisms to measure progress towards achieving the goals of this strategic plan. As important as it is to ensure assessment mechanisms are in place, it is equally important to limit additional burdens placed on agencies striving to achieve change. Therefore, leveraging existing practices, when and where possible, to serve as these assessment tools is preferred.

Table 4. Program Assessment Responsibilities, by Goal and Governance Level

Enabling Goals			Responsibility for Goals		
			Component Management*	JDMTP	OSD ManTech Office
Thrust 1	1.1	Enterprise-wide engagement to develop manufacturing technology priorities			
	1.2	Rigorous internal ManTech analysis and prioritization of the portfolio			
	1.3	Timely and effective delivery of defense-essential manufacturing technology solutions			
Thrust 2	2.1	Innovative, enterprise-level ManTech initiatives enabling collaborative and network-centric manufacturing			
	2.2	Robust deployment of ManTech Program results throughout the Defense Industrial Base.			
Thrust 3	3.1	Effective policies and practices to assess and improve manufacturing readiness			
	3.2	Full integration of "Design for Manufacturability" across the defense acquisition cycle			
	3.3	Structured analysis of manufacturing cost drivers for ManTech emphasis, in partnership with PEOs and Industry			
Thrust 4	4.1	Active promotion of investment and innovation in manufacturing infrastructure and management systems.			
	4.2	Effective ManTech contribution to a highly capable, well educated defense manufacturing workforce			

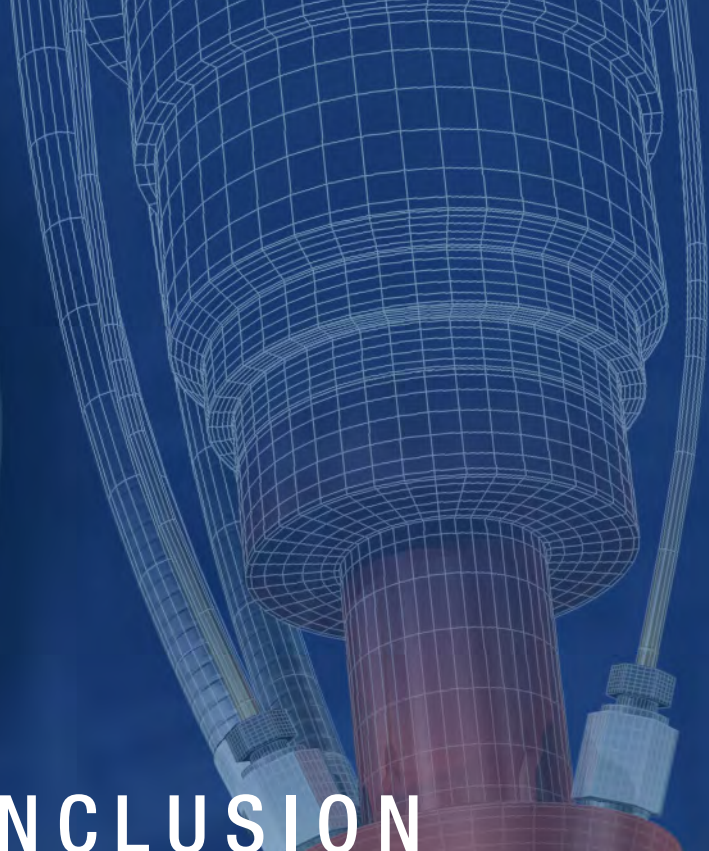
Primary Planning & Execution
 Secondary Planning & Execution
 Policy & Oversight
 Coordination & Review

Refer to Annexes D and E for additional information related to DoD ManTech Program governance structures and processes.

SUMMARY

OSD has primary responsibility to assess strategic, enterprise-level program performance and inform senior Department-level decision makers.

The operational layer of this joint strategy should be provided through a combination of tactical action planning/execution and ongoing assessments of program effectiveness. Component program execution plans and processes, in conjunction with JDMTP joint portfolio reviews and supporting activities, represent the key mechanisms to enable joint pursuit of the Department's prioritized manufacturing technology requirements. In terms of program assessment, 10 U.S.C. § 2521 establishes three levels of ManTech Program governance. Each level contains specific mechanisms and measures to assess the impact of the projects toward meeting the program's mission and the goals of this strategic plan. Together they provide a comprehensive and complementary assessment methodology to ensure a robust approach to support the health and resilience of the industrial base. To be successful in attaining the goals of this strategy, DoD ManTech Program leadership at all levels must remain tactically aware of critical joint opportunities and maintain a focus of continuous process improvement.



V. CONCLUSION

The DoD Manufacturing Technology Program has consistently demonstrated strong value over an extensive history of support to defense manufacturing. The continued pressure on defense budgets, combined with the need to rapidly transition technology to meet evolving threats, will only increase the program's importance as a key manufacturing enabler. This is true not just in terms of its support for basic product realization and performance, but also in terms of the program's potential to help the Department tackle its acute defense system affordability challenges through proven cost savings and cost avoidance.

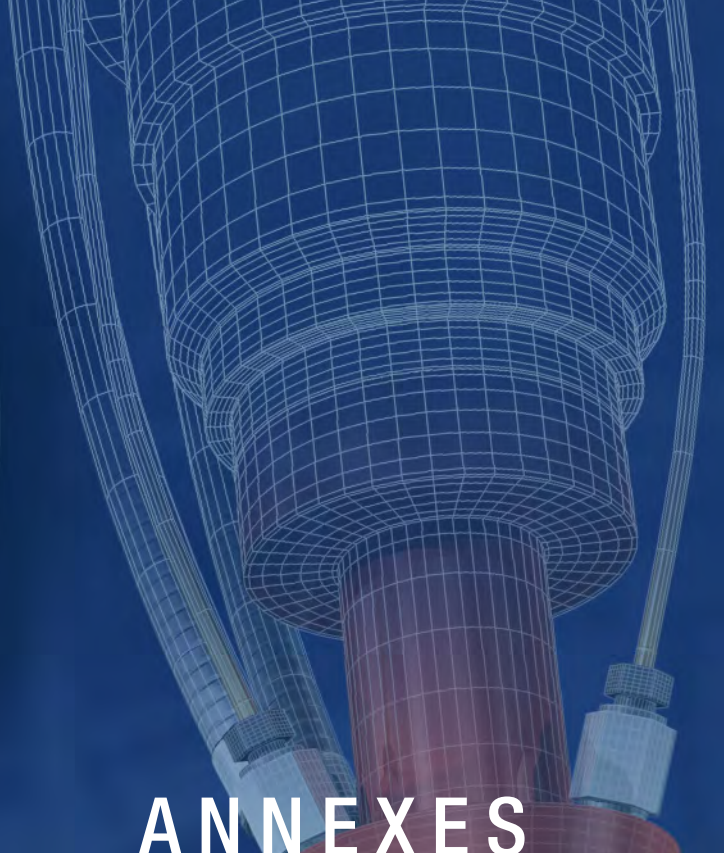
The dynamics of the 21st century are blurring the boundary between what has historically been a largely self-contained defense industrial base and the broader commercial marketplace, both nationally and globally. This increasingly intermixed manufacturing operating environment creates both challenges and opportunities for the program and the Department. The fundamental objective during strategic planning was to identify those traditional ManTech practices warranting tuning and strengthening, while also understanding where external dynamics are demanding broader adjustments to ensure full program resilience. The consensus conclusion was that the DoD ManTech Program has tremendous core strengths that will continue to benefit defense manufacturing in the future,



but they must be coupled with a highly flexible and adaptive posture to fully capitalize on 21st century changes.

This strategic plan reflects that balanced approach by leveraging ManTech's relatively modest investment base through a corporately developed set of strategic thrusts and enabling goals. The plan's ultimate objective is to enable this important DoD program to continue to create sustained, positive impacts for the warfighter in the tradition of its past while elevating ManTech's value and performance to even higher levels. The latter is achievable through the plan's structured, enterprise-level search for "game-changing" improvements. With the right leadership focus and teamwork across the DoD and industry, the result will be an even greater realization of the vision of "a responsive, world-class manufacturing capability to affordably and rapidly meet warfighter needs throughout the defense system life cycle."





ANNEXES

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ANNEX A: STATUTORY REQUIREMENTS

This annex provides excerpted statutory language from the following two federal documents:

- **Excerpt 1.** Section 2521 of Title 10, United States Code, (10 U.S.C. § 2521), as amended by in Public Law 110-181 (FY 2008 NDAA), describing the basic requirements for the Department of Defense Manufacturing Technology Program.
- **Excerpt 2.** Section 2501(a) of Title 10, United States Code (10 USC § 2501(a) as referenced in section 2521(a), National security objectives concerning national technology and industrial base.

EXCERPT 1. 10 U.S.C. § 2521, MANUFACTURING TECHNOLOGY PROGRAM

UNITED STATES CODE

TITLE 10—ARMED FORCES

Subtitle A—General Military Law

PART IV—SERVICE, SUPPLY, AND PROCUREMENT

CHAPTER 148—NATIONAL DEFENSE TECHNOLOGY AND INDUSTRIAL BASE, DEFENSE REINVESTMENT, AND DEFENSE CONVERSION

SUBCHAPTER IV—MANUFACTURING TECHNOLOGY

§ 2521. Manufacturing Technology Program

(a) **ESTABLISHMENT.**—The Secretary of Defense shall establish a Manufacturing Technology Program to further the national security objectives of section 2501(a) of this title through the development and application of advanced manufacturing technologies and processes that will reduce the acquisition and supportability costs of defense weapon systems and reduce manufacturing and repair cycle times across the life cycles of such systems. The Secretary shall use the joint planning process of the directors of the Department of Defense laboratories in establishing the program. The Under Secretary of Defense for Acquisition and Technology shall administer the program.

(b) **PURPOSE OF PROGRAM.**—The Secretary of Defense shall use the program—

- (1) to provide centralized guidance and direction (including goals, milestones, and priorities) to the military departments and the Defense Agencies on all matters relating to manufacturing technology;
- (2) to direct the development and implementation of Department of Defense plans, programs, projects, activities, and policies that promote the development and

application of advanced technologies to manufacturing processes, tools, and equipment;

- (3) to improve the manufacturing quality, productivity, technology, and practices of businesses and workers providing goods and services to the Department of Defense;
- (4) to focus Department of Defense support for the development and application of advanced manufacturing technologies and processes for use to meet manufacturing requirements that are essential to the national defense, as well as for repair and remanufacturing in support of the operations of systems commands, depots, air logistics centers, and shipyards;
- (5) to disseminate information concerning improved manufacturing improvement concepts, including information on such matters as best manufacturing practices, product data exchange specifications, computer-aided acquisition and logistics support, and rapid acquisition of manufactured parts;
- (6) to sustain and enhance the skills and capabilities of the manufacturing work force;
- (7) to promote high-performance work systems (with development and dissemination of production technologies that build upon the skills and capabilities of the work force), high levels of worker education and training; and
- (8) to ensure appropriate coordination between the manufacturing technology programs and industrial preparedness programs of the Department of Defense and similar programs undertaken by other departments and agencies of the Federal Government or by the private sector.

(c) EXECUTION.—

- (1) The Secretary may carry out projects under the program through the Secretaries of the military departments and the heads of the Defense Agencies.
- (2) In the establishment and review of requirements for an advanced manufacturing technology or process, the Secretary shall ensure the participation of those prospective technology users that are expected to be the users of that technology or process.
- (3) The Secretary shall ensure that each project under the program for the development of an advanced manufacturing technology or process includes an implementation plan for the transition of that technology or process to the prospective technology users that will be the users of that technology or process.
- (4) In the periodic review of a project under the program, the Secretary shall ensure participation by those prospective technology users that are the expected users for the technology or process being developed under the project.
- (5) In order to promote increased dissemination and end use of manufacturing

technology throughout the national defense technology and industrial base, the Secretary shall seek, to the maximum extent practicable, the participation of manufacturers of manufacturing equipment in the projects under the program.

- (6) In this subsection, the term `prospective technology users' means the following officials and elements of the Department of Defense:
- (A) Program and project managers for defense weapon systems.
 - (B) Systems commands.
 - (C) Depots.
 - (D) Air logistics centers.
 - (E) Shipyards.

(d) COMPETITION AND COST SHARING.—

- (1) In accordance with the policy stated in section 2374 of this title, competitive procedures shall be used for awarding all grants and entering into all contracts, cooperative agreements, and other transactions under the program.
- (2) Under the competitive procedures used, the factors to be considered in the evaluation of each proposed grant, contract, cooperative agreement, or other transaction for a project under the program shall include the extent to which that proposed transaction provides for the proposed recipient to share in the cost of the project. For a project for which the Government receives an offer from only one offeror, the contracting officer shall negotiate the ratio of contract recipient cost to Government cost that represents the best value to the Government.

(e) JOINT DEFENSE MANUFACTURING TECHNOLOGY PANEL.—

- (1) There is in the Department of Defense the Joint Defense Manufacturing Technology Panel.
- (2)
 - (A) The Chair of the Joint Defense Manufacturing Technology Panel shall be the head of the Panel. The Chair shall be appointed, on a rotating basis, from among the appropriate personnel of the military departments and Defense Agencies with manufacturing technology programs.
 - (B) The Panel shall be composed of at least one individual from among appropriate personnel of each military department and Defense Agency with manufacturing technology programs. The Panel may include as ex-officio members such individuals from other government organizations, academia, and industry as the Chair considers appropriate.
- (3) The purposes of the Panel shall be as follows:
 - (A) To identify and integrate requirements for the program.

- (B) To conduct joint planning for the program.
 - (C) To develop joint strategies for the program.
- (4) In carrying out the purposes specified in paragraph (3), the Panel shall perform the functions as follows:
- (A) Conduct comprehensive reviews and assessments of defense-related manufacturing issues being addressed by the manufacturing technology programs and related activities of the Department of Defense.
 - (B) Execute strategic planning to identify joint planning opportunities for increased cooperation in the development and implementation of technological products and the leveraging of funding for such purposes with the private sector and other government agencies.
 - (C) Ensure the integration and coordination of requirements and programs under the program with the Office of the Secretary of Defense and other national-level initiatives, including the establishment of information exchange processes with other government agencies, private industry, academia, and professional associations.
 - (D) Conduct such other functions as the Under Secretary of Defense for Acquisition, Technology, and Logistics shall specify.
- (5) The Panel shall report to and receive direction from the Assistant Secretary of Defense for Research and Engineering on manufacturing technology issues of multi-service concern and application.
- (6) The administrative expenses of the Panel shall be borne by each military department and Defense Agency with manufacturing technology programs in such manner as the Panel shall provide.
- (f) FIVE-YEAR STRATEGIC PLAN.—
- (1) The Secretary shall develop a plan for the program that includes the following:
 - (A) The overall manufacturing technology goals, milestones, priorities, and investment strategy for the program.
 - (B) The objectives of, and funding for, the program for each military department and each Defense Agency that shall participate in the program during the period of the plan.
 - (2) The Secretary shall include in the plan mechanisms for assessing the effectiveness of the program under the plan.
 - (3) The Secretary shall update the plan on a biennial basis.
 - (4) Each plan, and each update to the plan, shall cover a period of five fiscal years.

Added Pub. L. 103-160, div. A, title VIII, §801(a)(1), Nov. 30, 1993, 107 Stat. 1700, §2525; amended Pub. L. 103-337, div. A, title II, §256(a)(1), Oct. 5, 1994, 108 Stat. 2704; Pub. L. 104-106, div. A, title II, §276(a), title X, §1081(e), title XV, §1503(a)(28), Feb. 10, 1996, 110 Stat. 241, 454, 512; Pub. L. 105-85, div. A, title II, §211(a), (b), Nov. 18, 1997, 111 Stat. 1657; Pub. L. 105-261, div. A, title II, §213, Oct. 17, 1998, 112 Stat. 1947; Pub. L. 106-65, div. A, title II, §216, Oct. 5, 1999, 113 Stat. 543; renumbered §2521, Pub. L. 106-398, §1 [[div. A], title III, §344(c)(1)(A)], Oct. 30, 2000, 114 Stat. 1654, 1654A-71; Pub. L. 107-107, div. A, title X, §1048(b)(2), Dec. 28, 2001, 115 Stat. 1225; Pub. L. 107-314, div. A, title II, §213, Dec. 2, 2002, 116 Stat. 2481; Pub. L. 108-136, div. A, title X, §1031(a)(24), Nov. 24, 2003, 117 Stat. 1598; Pub. L. 110-181, div. A, title II, §238(a), Jan. 28, 2008, 122 Stat. 48; Pub. L. 111-84, div. A, title II, §212, Oct. 28, 2009, 123 Stat. 2225; Pub. L. 111-383, div. A, title IX, §901(a)(2), Jan. 7, 2011, 124 Stat. 4317.

EXCERPT 2. 10 U.S.C. § 2501(A), NATIONAL SECURITY OBJECTIVES CONCERNING NATIONAL TECHNOLOGY AND INDUSTRIAL BASE

- (a) National Security Objectives for National Technology and Industrial Base.— It is the policy of Congress that the national technology and industrial base be capable of meeting the following national security objectives:
 - (1) Supplying, equipping, and supporting the force structure of the armed forces that is necessary to achieve—
 - (A) the objectives set forth in the national security strategy report submitted to Congress by the President pursuant to section 108 of the National Security Act of 1947 (50 U.S.C. 404a);
 - (B) the policy guidance of the Secretary of Defense provided pursuant to section 113 (g) of this title; and
 - (C) the future-years defense program submitted to Congress by the Secretary of Defense pursuant to section 221 of this title.
 - (2) Sustaining production, maintenance, repair, logistics, and other activities in support of military operations of various durations and intensity.
 - (3) Maintaining advanced research and development activities to provide the armed forces with systems capable of ensuring technological superiority over potential adversaries.
 - (4) Reconstituting within a reasonable period the capability to develop, produce, and support supplies and equipment, including technologically advanced systems, in sufficient quantities to prepare fully for a war, national emergency, or mobilization of the armed forces before the commencement of that war, national emergency, or mobilization.
 - (5) Providing for the development, manufacture, and supply of items and technologies critical to the production and sustainment of advanced military weapon systems within the national technology and industrial base.

- (6) Providing for the generation of services capabilities that are not core functions of the armed forces and that are critical to military operations within the national technology and industrial base.
- (7) Providing for the development, production, and integration of information technology within the national technology and industrial base.
- (8) Maintaining critical design skills to ensure that the armed forces are provided with systems capable of ensuring technological superiority over potential adversaries.

Added Pub. L. 102-484, div. D, title XLII, §4211, Oct. 23, 1992, 106 Stat. 2662; amended Pub. L. 103-35, title II, §201(c)(7), May 31, 1993, 107 Stat. 98; Pub. L. 103-160, div. A, title XI, §1182(a)(10), title XIII, §1313, Nov. 30, 1993, 107 Stat. 1771, 1786; Pub. L. 104-106, div. A, title X, §1081(a), Feb. 10, 1996, 110 Stat. 452; Pub. L. 104-201, div. A, title VIII, §829(a), Sept. 23, 1996, 110 Stat. 2612; Pub. L. 111-23, title III, §303(a), May 22, 2009, 123 Stat. 1731; Pub. L. 111-383, div. A, title VIII, §895(b), Jan. 7, 2011, 124 Stat. 4314.

ANNEX B: STRATEGIC PLANNING CONSTRUCT

This strategic plan establishes appropriate Department-level direction to align, unify, and guide the ManTech enterprise to maximize its value to the warfighter, DoD, and the nation. It meets the statutory direction in 10 U.S.C. § 2521 requiring the SECDEF to develop and regularly update a five-year strategic plan for the program (see Annex A).

The planning methodology underpinning the strategic guidance in this document took a broad view of defense manufacturing as an enterprise level system. The methodology focused on:

- Fully exploring and defining the enterprise, its purpose, its boundaries, and its extended interfaces, including understanding:
 - The basis for the ManTech Program through a detailed review of statutory and Departmental intent and program history
 - Required program capabilities
- Understanding the strategic context within which the enterprise operates, including how it may be changing
- Carefully identifying the population of key program stakeholders (both active and passive)
- Engaging with a sufficiently representative population of government and industry stakeholders (S&T leaders, defense system PMs and PEOs, and other senior decision makers) to:
 - Establish a rich source of perspectives, or “demand signals,” and
 - Identify ManTech and manufacturing enterprise capability gaps and priorities.

The planning effort also involved literature reviews of the following families of documents to help baseline the program and develop its strategic context (see Annex G for a listing of references):

- Key ManTech Program directives and governance documents
- Published plans and strategy documents influencing the DoD and Component ManTech programs
- Recent key reports and studies, both governmental and non-governmental
- Other influential or relevant documents, including key historical reports and initiatives

This systems approach provided perspectives through which the mission, environment, and circumstances of the DoD ManTech Program could be completely understood. It also led to a consensus view that the program’s unique governance model, which centrally relies on the JDMTP framework (detailed in Annex D), is an appropriate one for the ManTech mission. It is an evolved design for governing an essentially “federated” enterprise of Component-level manufacturing technology investment programs reporting through Component S&T channels, with very broad OSD oversight and integration.

Therefore, it was agreed that the guidance in this DoD-level strategic plan should enhance that basic framework by striking an important balance between:

- Providing sufficient, Component autonomy to support Component-level warfighter support priorities
- Meeting collective, defense-wide ManTech priorities and needs

Continually assessing and maintaining a proper balance between the two is important in order to maximize overall program effectiveness and value to the Department.

For similar reasons, the guidance and direction in this DoD-level strategic plan focuses primarily on the broad strategic thrusts and enabling goals that a federation of Component-managed programs should be expected to *collectively* support. Formulation and evaluation of specific courses of action as well as risk tradeoff decisions in support of the program's ten enabling goals will necessarily take different forms *within* each of the managing Components (with the caveat that OSD's Defense-wide Manufacturing Science & Technology (DMS&T) Program and JDMTP activities serve important cross-Component coordinating functions). The major elements of this strategic plan are therefore intended to enable effective, enterprise-wide unity of effort and to enable follow-on Component development of appropriately detailed execution plans.

Finally, current statute requires that this strategic plan be updated biennially, which provides an excellent basis for regular assessments of the plan's effectiveness and an opportunity to adjust the guidance therein.

ANNEX C: OFFICE OF THE DEPUTY ASSISTANT SECRETARY OF DEFENSE FOR MANUFACTURING AND INDUSTRIAL BASE POLICY (ODASD(MIBP))

Given current budget realities and the wide-ranging mission of the DoD, a critical challenge is to maintain the health of the defense industrial base in a constrained fiscal environment. To that end, Section 896 of the Fiscal Year 2011 National Defense Authorization Act (NDAA) established the position of Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy, codifying its responsibilities in 10 U.S.C. § 139(c), expanding the duties (and title) of the previous Industrial Policy office. The inclusion of “manufacturing” in the title ensured the linkage between “industrial base” and “manufacturing” was firmly established and effectively coordinated.

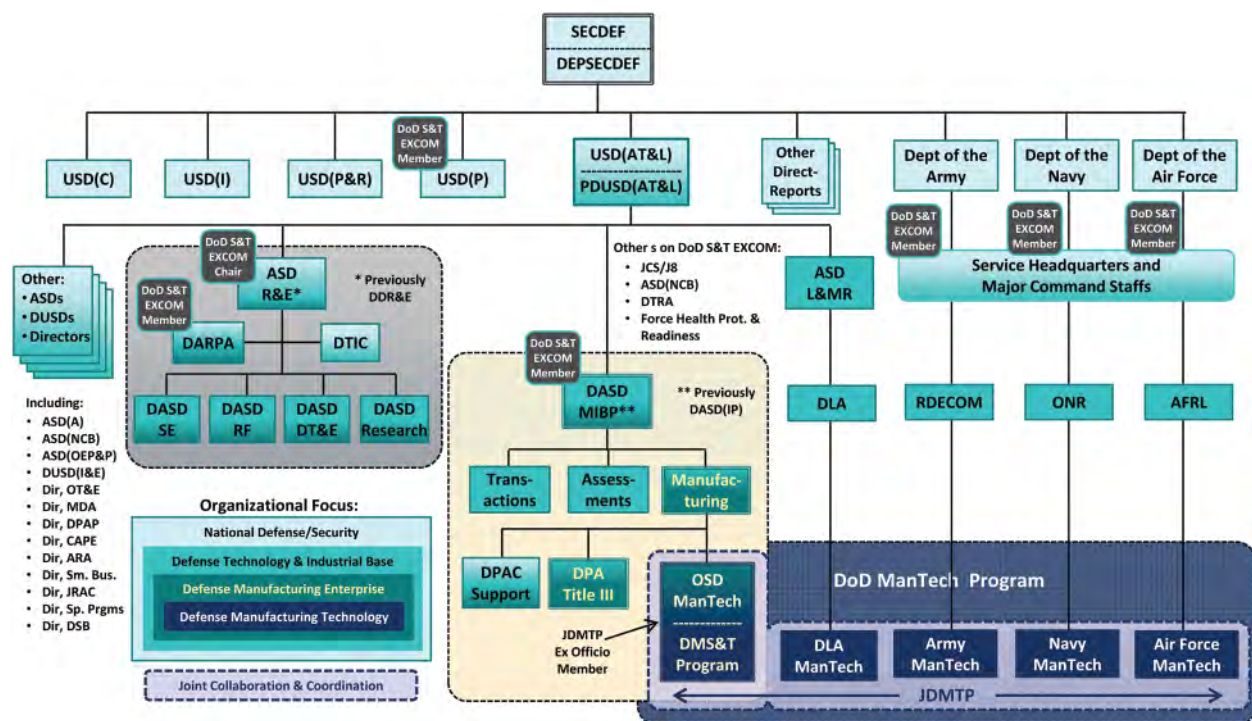


Figure C-1. ODASD (Manufacturing and Industrial Base Policy)

Reporting to the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)), the mission of the Office of Manufacturing and Industrial Base Policy (MIBP) is to sustain an environment that ensures the manufacturing and industrial base on which the Department of Defense (DoD) depends is healthy, responsive, and resilient in meeting DoD requirements. Organizationally, it fits within the broader DoD enterprise of manufacturing/production and broader industrial interests as reflected in Figure C-1. Specifically, MIBP is responsible to ensure that DoD policies, procedures, and actions: (1) stimulate and support vigorous competition and innovation in the industrial base supporting defense; and (2) establish and sustain cost-effective industrial and technological capabilities that assure military readiness and superiority.

MIBP does so by: (1) monitoring industry readiness, competitiveness, ability to innovate, and financial stability as the Department moves to capabilities-based acquisitions in an era of increasingly sophisticated systems; (2) leveraging DoD research and development, acquisition, and logistics decisions to promote innovation, competition, military readiness, and national security; (3) leveraging statutory processes (for example, the Defense Priorities and Allocations System, Hart-Scott-Rodino antitrust evaluations, Exon-Florio Committee on Foreign Investment in the United States evaluations) also to promote innovation, competition, military readiness, and national security; and (4) leading efforts for the Department to engage with industry to ensure openness and transparency with the goal of increasing effective public-private partnerships.

MIBP has oversight responsibility for several DoD programs that help ensure the domestic and global manufacturing and industrial base is fully capable of meeting the current and future product and service needs of the Warfighter. DASD(MIBP) is organized into three directorates (see Figure C-1): Manufacturing, Assessments and Transactions. Each is discussed below.

Manufacturing:

- **ManTech:** Under the 2011 NDAA, responsibility for executing the authorities of the DoD Manufacturing Technology (ManTech) Program under 10 U.S.C. 2521 shifted to MIBP. ManTech, whose mission is to develop technologies and processes that ensure the affordable and timely production and sustainment of defense systems, are discussed in greater detail in Annex D.
- **Defense Production Act (DPA) Programs:** MIBP has several programs related to the DPA. The DPA grants the President powers to ensure the availability and timely delivery of products, materials, and services to military and civilian agencies. It codifies a robust Presidential legal authority to enlist industry to give priority to national security production and provides for statutory review of foreign investment in U.S. companies.
 - **DPA Title III - Expanding Production Capability and Supply:** The mission of Title III of the Defense Production Act is to create assured, affordable and commercially viable production capabilities and capacities for items essential for national defense. The Title III Program is a government-funded venture that aides manufacturers who specialize in materials used for defense applications. Production capabilities that would otherwise be inadequate are enhanced to support the material requirements of defense programs in a timely and affordable manner. Title III focuses on materials and components that could be used in a broad spectrum of defense systems. The direct and indirect

benefits to defense programs resulting from Title III initiatives are substantial. Moreover, Title III projects create numerous economic and technological benefits for domestic industries and consumers.

- Defense Production Act Committee (DPAC): The DPAC is an interagency body, established in 2009, to advise the President on DPA authorities and policies to ensure timely availability and delivery of industrial resources to meet national security needs. MIBP serves as the Executive Secretariat for the DPAC. A core mission of the DPAC Executive Secretariat is to provide overall policy guidance and execution of DPA authorities.

Assessments:

- S2T2: To improve the DoD's ability to develop successful acquisition strategies and to deliver advanced capabilities to the warfighter at reasonable cost to the taxpayer, MIBP is pursuing multiple, concurrent efforts to map and better understand the entire defense industrial base. This project, Sector-by-Sector, Tier-by-Tier (S2T2), is focused on improving the DoD's understanding of the defense industry, supplying the Department with fact-based analysis, and developing an industrial base data repository to serve as a jumping off point for future assessments by all DoD Components. As one of its multiple tracks, ManTech is a contributor to and consumer of S2T2.
- DPA Title I - Defense Priorities and Allocations System (DPAS): The DPAS is a mechanism to assure the availability of industrial resources to meet national defense requirements and provides a framework for rapidly expanding industrial resources during national emergencies.

Transactions:

- Security of Supply: To ensure the mutual supply of defense goods and services originating outside the United States, the DoD has entered into bilateral Security of Supply arrangements. These arrangements allow the DoD to request priority delivery for DoD contracts, subcontracts, or orders from companies in these countries.
- DPA Title VII - CFIUS: The Committee on Foreign Investment in the United States (CFIUS) has authority delegated from the President to conduct national security reviews of foreign acquisitions of U.S.-based firms under the Exon-Florio Amendment to the Defense Production Act.

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ANNEX D: THE DOD MANTECH PROGRAM – ADDITIONAL INFORMATION

This annex provides additional information on the DoD ManTech Program, including its organization and investment processes. The Department's Manufacturing Technology Program is founded in Section 2521 of 10 United States Code, which summarizes the program as follows:

[T]o further...national security objectives...through the development and application of advanced manufacturing technologies and processes that will reduce the acquisition and supportability costs of defense weapon systems and reduce manufacturing and repair cycle times across the life cycles of such systems.²³

The combination of 10 U.S.C. § 2521 and DoD Directive (DODD) 4200.15 assigns responsibility for administering the DoD ManTech Program under the authority, direction, and control of the USD(AT&L), and guides OSD administration of the program, issuing requirements to:

- Provide centralized guidance and direction for the ManTech Program within the DoD and ensure that it is executed in accordance with set directives.
- Develop and maintain a joint planning process, and use that process in preparing centralized program guidance.
- Ensure coordination between the ManTech Program and industrial preparedness and similar manufacturing programs of DoD, other Departments and Agencies, and the private sector.

The program's mission is therefore multi-faceted and vital; namely, *DoD ManTech anticipates and closes gaps in manufacturing capabilities for affordable, timely, and low-risk development, production, and sustainment of defense systems*. The program looks beyond the normal risk of industry and directs investments at improving the quality, productivity, technology, and practices of businesses and workers providing goods and services to the DoD. Department of Defense Directive (DODD) 4200.15 further defines this essential, continuing mission, requiring the ManTech Program to:

- Aid in the economical and timely acquisition and sustainment of weapon systems and components
- Ensure that advanced manufacturing processes, techniques, and equipment are available for reducing DoD material acquisition, maintenance and repair costs
- Advance the maturity of manufacturing processes to bridge the gap from research and development advances to full- scale production

²³ 10 U.S.C. § 2521(a)

- Promote capital investment and industrial innovation in new plants and equipment by reducing the cost and risk of advancing and applying new and improved manufacturing technology
- Ensure that manufacturing technologies used to produce DoD materiel are consistent with safety and environmental considerations and energy conservation objectives
- Provide for the dissemination of program results throughout the industrial base
- Sustain and enhance the skills and capabilities of the manufacturing work force, and promote high levels of worker education and training

When viewed in the aggregate, ManTech's charter is broad, but its budget is limited. Program-wide annual budget submissions (FY13-FY17) average around \$200 million, or about 1/3 percent of DoD RDT&E funding. A disciplined, integrated, and prioritized strategy is thus necessary to develop policies and apply resources—financial, human capital, infrastructure, and intellectual property—to best meet its mission. ManTech applies the following four tenets to help establish priorities:

1. Address the highest priority defense manufacturing needs in the window of opportunity to make a difference.
2. Transition manufacturing R&D processes into production applications.
3. Attack pervasive manufacturing issues and exploit new opportunities across industry sectors.
4. Address manufacturing technology requirements beyond the normal risk of industry.

These tenets are the program's guides for making sound policy and resource allocation decisions. While these tenets are extremely useful in this regard, it is equally important that the DoD ManTech Program be properly organized to oversee, execute, and coordinate these essential policy and resource allocation functions across the Department. These organizational facets are discussed next.

To ensure that investments of energy and resources are appropriately allocated across the spectrum of warfighter needs and requirements, a ManTech office is located within each of the Military Departments (Army, Navy, Air Force) as well as DLA, and each manages a formal program element (PE). While each executing Component manages its ManTech investment

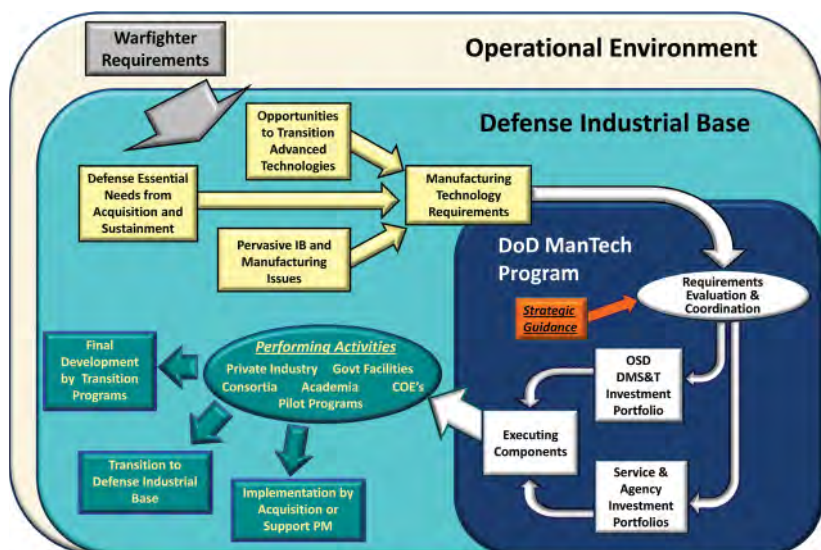


Figure D-1. ManTech Investment Process

portfolio in tailored ways to meet Component-specific mission needs, all are bound collectively by 10 U.S.C. 2521 and DODD 4200.15 and operate within the broad, high-level investment process framework in Figure D-1. The framework depicts the major attributes of the three-phase process of (1) ManTech requirements determination, (2) identification and prioritization of strategic initiatives and projects, and (3) project selection and execution; both within programs and organizations and across their boundaries. Coordination among each of these ManTech programs is recognized by all as essential to achieving broader outcomes.

Title 10 U.S.C. § 2521
“The purposes of the [JDMTP] shall be as follows:
(A) To identify and integrate requirements for the program.
(B) To conduct joint planning for the program.
(C) To develop joint strategies for the program.”

This critical need for multi-service leverage and technical portfolio management prompted the 1999 creation of a coordination body known as the Joint Defense Manufacturing Technology Panel (JDMTP)—(see Figure D-2). Over the past decade the concept has proven extremely effective, and Congress, recognizing the value to the Department, subsequently codified the JDMTP in 10 U.S.C. § 2521(e) via the FY 2010 NDAA. The organization embodies two tiers of coordination: a “Principal” panel, comprised of a senior technology manager from each program Component, overseeing a series of technical “subpanels,” each associated with specific technology sectors (presently Metals, Composites, Electronics, and Advanced Manufacturing

Enterprise (AME)). Both organizational tiers of the JDMTP have multi-Component membership and work together to “identify and integrate requirements, conduct joint program planning, and develop joint strategies for the ManTech programs conducted by the Army, Navy, Air Force, and Defense Logistics Agency.”²⁴ The JDMTP Principals typically meet monthly to guide the panel’s strategic mission and high-level investment topics, while the entire panel meets semi-annually to monitor the execution of ManTech initiatives and provide status updates for subpanel activities. The technical subpanels generally meet quarterly to assess the technical portfolio, develop multi-service investment topics, and jointly plan technical activities. To facilitate this process, and to provide support for peer review and technology transfer, the JDMTP has developed a structured annual review of the ManTech portfolio of projects,

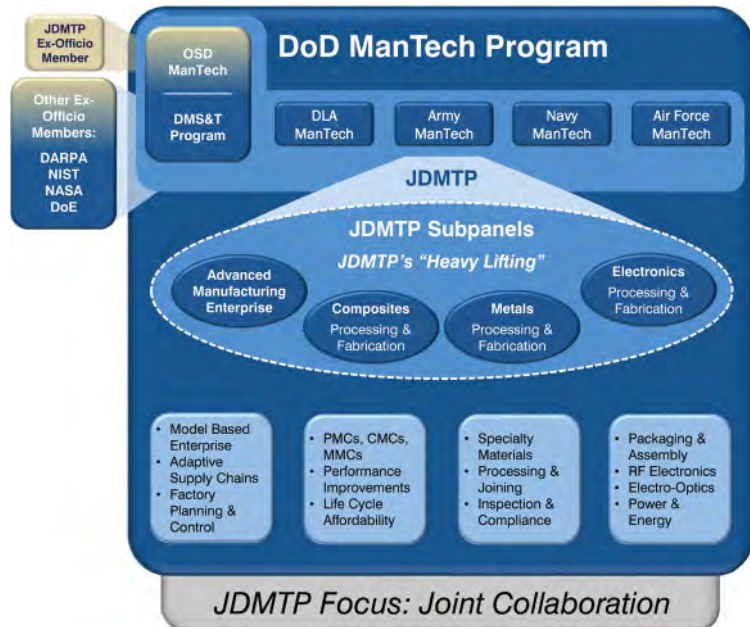


Figure D-2. JDMTP Organization

24 “Charter Joint Defense Manufacturing Technology Panel,” June 8, 1999, p. 1.

divided by technical topic area and conducted by the subpanels. Additionally, the subpanels are annually tasked with constructing a short list of the most important joint technology pursuit areas within the subpanel's domain. These technical pursuits represent joint manufacturing topics that will develop the highest value, affordable, leading edge defense capabilities.

JDMP Portfolio Review Process

The history of ManTech's joint portfolio review process can be traced back to the 1990s, when ManTech fell under the purview of the Technology Area Review and Assessment (TARA) process. At that time, the ManTech Program was required to present an all-inclusive program review each January in support of the TARA process. In 2002, ManTech was relieved of its requirement. However, finding value in the review process, ManTech continued the annual portfolio review, with oversight by the JDMP. As shown in Figure D-3, the portfolio review cycle begins each March with JDMP

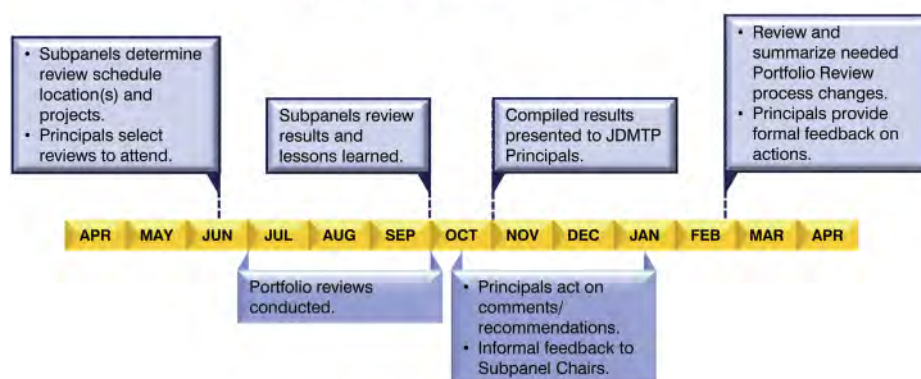


Figure D-3. JDMP Portfolio Review Timeline

subpanel members developing a list of projects to be reviewed. Later, independent industry subject matter experts are identified to participate in the review along with the subpanel members. Subpanel review plans are reviewed and approved by the JDMP Principals in April. Between April and September of each year, subpanels conduct a rigorous review of each of their identified projects. These reviews provide an analysis that covers a broad scope of technical and program management, transition planning, and leverage opportunities. These reviews provide a comprehensive view of the portfolio contents for the peer-group.

Principals are invited to all of these reviews and are encouraged to attend. The JDMP subpanels, with support from identified industry experts, rate each of their portfolio projects. Each project is evaluated and rated on a scale of 1 to 5 in the following categories :²⁵

²⁵ These portfolio review assessment categories are currently in use, but as noted in Section IV, the JDMP has recently established a working group to study and make recommendations regarding updated subpanel portfolio review processes and metrics. This working group has recommended a different set of assessment categories, which are under review by the JDMP.

1. *Customer Needs and Benefits.* Target customers and important customer requirements have been identified and a clear and compelling story on benefits is stated. This includes a baseline, quantifiable benefits with targets, and a credible rationale for estimates. If possible, a clear case for pervasive benefits is established.
2. *Technical Metrics.* Measurable objectives have been established for the project which relate to key customer requirements. Goals and threshold values have been established for each of the key objectives and units of measurement have been defined that can be used to measure progress towards the goals.
3. *Progress.* The project is on schedule and progress to date is in line with the funding expended to date. The project is likely to meet or exceed all of its established goals within the currently available funding and on the projected schedule.
4. *Technology Transition.* An implementing organization or customer is directly involved in planning for transition of the technology and is committed to implement the project results if threshold values for the objectives are met. All deliverables necessary for effective transition are on contract or otherwise addressed, with a clear and credible implementation strategy in place with funding identified for qualification or other implementation expenses.
5. *Leveraging or Sharing of Resources.* The project is taking appropriate advantage of the results of previous and current related work both within and outside of the defense industry, as well as utilizing opportunities for funding or other resource support from industry, other DoD organizations, universities, or other agencies and organizations.

Each October, subpanel organizations present a summary of the review results to the JDMTP. Results of these assessments are used for a variety of purposes. Trends can be established in a portfolio that can drive future actions. If projects are rated unusually low in one or more of the rating criteria, the JDMTP Principals can use the results to identify potential management actions on programs managed by their Service or Agency. Programs that are rated unusually high are considered for awards or other recognition.

Industry Coordination

The DoD ManTech Program, through the JDMTP, coordinates with the defense manufacturing industry through its industry liaison partner, the National Center for Advanced Technologies (NCAT). The Center is a not-for-profit organization with the goal of facilitating communication between industry, academic and government communities in order to promote affordability and to reduce the cycle time for technology transition. ManTech leverages the industry and academic partnerships of NCAT to address technological and management issues such as Technology Transition Initiatives, Manufacturing Readiness Levels and Assessments, and Manufacturing Technology Roadmaps, etc.

DoD ManTech relies on NCAT to identify and draw on the resources of stakeholder representatives from Industry, Academia and Government and then facilitate industry participation in the JDMTP through the Multi-Association Industry Affordability Task Force. DoD and industry work together to address common issues facing both industry and DoD communities.

The current membership of the Multi-Association Industry Affordability Task Force includes the members from the industry associations and professional societies listed below:

- Aerospace Industries Association of America (AIA)
- TechAmerica / Government Electronic Industries Alliance (GEIA)
- National Defense Industrial Association (NDIA)
- Society of Manufacturing Engineers (SME)
- The Association for Manufacturing Technology (AMT)
- National Council for Advanced Manufacturing (NACFAM)
- National Center for Manufacturing Sciences (NCMS)
- National Center For Defense Manufacturing and Machining (NCDMM)

Current ManTech Technology Pursuit Areas

The following technology initiatives are organized by subpanel (Electronics, Composites, Metals and AME) and then by taxonomy areas within each domain. This listing does not feature any priority order. These technical descriptions include both current and future programmed investments as well as unfunded initiatives that are being pursued based upon future warfighter capability needs. In some cases, technical roadmaps will be constructed to establish formal capability, schedule or cost gaps against defense system requirements, which will help to prioritize investments within these topics.

Electronics Investment Area

- RF Devices:
 - RF devices/modules for AESA antennas, including phase shifters, SiC/GaN devices and MMICs
 - RF components for affordable data-links
 - WBG Material (Substrate) improved quality manufacturing for yield, reliability and affordability
 - Thermal management materials, devices, and processes for RF modules
 - Hybrid semiconductor/VED microwave power modules
- Power and Energy:
 - High power, high energy density, Lithium-ion batteries to support platform (silent/quiet) mobility, and silent watch platform capabilities
 - SiC high power switching device fabrication and high temp packaging for shipboard power and more electric aircraft

- Thermal management materials, devices, and processes for high-power modules
- Fuel cells for portable, mobile, and vehicular applications
- High energy throwaway batteries for C4ISR applications
- Reserve batteries for weapons systems applications
- R/EO:
 - Next-generation uncooled IR sensors for Soldier Systems
 - High-power SiC PiN Diode Manufacturing
 - High-resolution Micro-Display components
 - Multispectral Mid-IR lasers for DIRCM
 - Next-generation communications (such as software defined or optical-based)
 - Yield improvement of Large Format Long Wave IR sensors
- Affordable High Definition and Very Large Format Focal Plane Arrays for LWIR Tactical and Strategic Applications leveraging III-V Detector Material MEMS:
 - Low-cost, high-reliability RF MEMS devices
- Nanotechnology:
 - Carbon nanotube-enhanced ultra-capacitors for high power and alternate power applications
 - Carbon nanotube-based 3-dimensional solar cells
- Sensors:
 - Flexible displays used by soldier systems for both dismounted and mobile applications
 - Sensors and networks for embedded composites
 - Low-cost, high-reliability 3-dimensional printing of electronic sensors for embedded systems monitoring
 - Low-temperature, low-power LCD displays
- Packaging:
 - Advanced microcircuits emulation for obsolescence mitigation
 - High-power high-density interconnect technologies
 - High-temperature passive components
 - High-temperature power electronics packaging (280°C)
 - Integrated MEMS packaging, including high-G capability
 - Lead-free: investigate new materials solutions, publish standards, repair/rework processes, control the supply chain
 - Solder-free components and assemblies
 - Low-cost, lightweight electronic enclosures with high thermal conductivity

Composites Investment Area

- Light Weight Structures:
 - Affordable airframe technology for broad application to remote and direct piloted fixed and rotary wing vehicles
- Marine Structures:
 - Large marine qualified structures for ship and submarine applications reducing acquisition and sustainment costs
- High-temperature Structures:
 - Ceramic matrix composites for engines to realize lower weight thereby enabling increased performance and engine growth
 - Complex hot structures manufacturing for high mach, global reach vehicles
 - High-temperature (> 500°F) organic matrix and hybrid composites for secondary structures
- Specialty Structures:
 - Conformal sensor/composite structure manufacturing and maintenance technologies for enhanced battle space awareness and aircraft performance
 - Hybridized composite structures for body armor
 - Lower cost, improved quality transparency manufacture
- Rapid Manufacturing:
 - Out of autoclave manufacturing reducing cycle time and recurring tooling costs

Metals Investment Area

- Advanced Materials:
 - Metal alloy equivalency: substituting older qualified alloys which are out of production with newer metal alloys that have a robust supply chain. This will require completion of statistically adequate databases for the Metals Handbook
 - Replacement materials for REACH requirements: reaction to global policies for hazardous materials, particularly in corrosion protection
- Advanced/Intelligent machining:
 - Intelligent machining network modeling and standards
 - Advanced precision and thin walled machining
 - Precision robotic drilling within 3-dimensional structures
 - Smart machine platform initiative, “first part correct”
- Joining:
 - Bonding of metal and ceramic armor materials for improved efficiency and bond strength
 - Translational friction welding
 - Shipyard welding precision: increase the precision and fit of welding processes for shipyard build processes

- Titanium welding/brazing with alternate filler materials
- Higher efficiency gas metal arc/hybrid processes for steel fabrication
- Planned distortion control for shipbuilding plates and structures
- Lightweight ground vehicle manufacturing
- Advanced casting processes for lightweight alloys, that is, ablative process, continuous fiber reinforcement, particulate reinforcement, etc.
- Affordable lightweight structural and appliqué armor, and titanium for lightweight armament and ground vehicles which will also be broadly applicable to future up-armor requirements
- Next generation of metal matrix composites for armor and backing materials
- Casting and forgings:
 - Castings affordability initiative to continue significantly reducing the inherent cycle time limitations for the castings industry
 - Forging industry database: reducing cost through the forging supply chain database
 - Performance-based NDE standards
 - Casting design for manufacturing and performance
 - Casting production and performance modeling
 - Improved alloys for weight-sensitive performance
 - Tool-less manufacturing
 - Post processing such as hiping for high-strength steel castings

AME Investment Areas

- Connecting the Enterprise – Enable seamless interoperability of data and processes across organizational boundaries.
 - Develop tools and methods to improve supply network integration and management, such as:
 - Advanced sourcing marketplace development for DoD parts needs
 - Cloud-based service infrastructure for small manufacturers
 - Supplier risk assessment tools that monitor financial viability, and track potential risks such as natural disasters, labor disputes, geopolitical conflicts, etc.
 - Real-time asset management methods for material costs, routings, and inventories
 - Support development of Service Oriented Manufacturing (SOM) tools and processes
 - Networked sensors throughout the enterprise for enhanced communication, planning and control
 - Communication improvements enabled by software-neutral viewers, technical data exchange standards and tools that facilitate and archive collaboration
 - Technologies that provide visibility into the manufacturing processes of the extended supply chain and a common master schedule

- Agility improvements enabled by the distribution of details about supply chain participants and their roles, common contract terms and outcome-oriented acquisition strategies
- Robust engineering change management tools that communicate changes immediately throughout the entire supply chain
- Robust database of suppliers that includes multiple layers of capabilities (machines, processes, ability to collaborate, ability to innovate)
- Sourcing tools that streamline the sourcing process, making it easier to solicit more suppliers with less effort while protecting intellectual property
- “Available capacity” matchmaking that allows suppliers to anonymously post available capacity for given manufacturing processes
- Methods for governing the supply network
- Methods for a “self-regulating network” that uses incentives, inhibitors and standards to reward collaboration, innovation and interoperability solutions
- Modeling and simulation of supply networks with large scale optimization
- Sourcing tools that streamline the sourcing process, making it easier to solicit more suppliers with less effort while protecting intellectual property
- Streamlined processes for managing and protecting intellectual property
- Building the Digital Thread – Drive a continuous flow of integrated design, analysis, and manufacturing information throughout the product/system life cycle.
 - Develop tools to enable better designs, through:
 - Design automation allowing human designers to work at higher levels of abstraction
 - Model-based system verification
 - Models and simulations that allow rapid prediction of as-built product performance, reducing the need for physical qualification, prototyping, and pilot production
 - Facilitation of concurrent, cross-disciplinary design, development and manufacture
 - Models that capture design intent
 - Improved tools for sustainability/maintainability/lifecycle analysis
 - Models that can be used as trade analysis and decision support tools relating to performance attributes, including manufacturing, operation, maintenance, replacements, environmental and impacts
 - Improved design visualization
 - Platform based engineering
 - Producibility databases and analysis capabilities
- Enhance interoperability through:
 - Technology development & implementation initiatives, such as:

- Establishing interface protocols that permit manufactures to seamlessly interface with higher levels of design abstraction
- Use of standards-enabled CAD/CAM packages
- Integrated product/service systems
- Using information modeling to incorporate standard formats for like-domain and cross-domain decision making tools and processes
- Leadership and policy initiatives, such as:
 - Providing a forum for driving all electronic enterprise standards
 - Policy, infrastructure and standards; not mandated common tools
 - Organizing an information backbone of relevant standards
 - Standards for storing and sharing information
- Develop and implement improved 3D Technical Data Packages through:
 - Technology development & implementation initiatives, such as:
 - Methods for improved validation of data passed from one software package to another
 - Supporting pilot demonstrations of model-based processes
 - Building the business case (cost justification) for 3D TDP implementation by capturing savings data
 - Leadership and policy initiatives, such as:
 - Supporting updates to MIL-STD 31000
 - Evaluating existing relevant standards and practices and revise as appropriate
 - Establishing other relevant standards as appropriate
 - Assisting industry, particularly small and medium sized businesses, in adopting the relevant tools and practices
 - Supporting use of 3D TDPs in defense procurement contracts
- Creating an Agile Factory Floor – Develop adaptive manufacturing capabilities that integrate factory floor resources for rapid response to the warfighter.
 - Develop tools and methods to implement intelligent manufacturing, such as:
 - Metrology tools and methods for real-time handling of manufacturing information
 - On and off machine inspection, test, and measurement
 - Sensors networks for data capture and machine-to-machine communication for real-time monitoring of material flows and resource use
 - Physics-based models that reliably predict the behavior of manufacturing processes
 - Equipment and software that is integrated and self-aware (via sensors) so it can recognize its condition and report it to interoperating devices so they can respond appropriately
 - Scientific and engineering databases that are available to designers

- Human interfaces that facilitate timely and appropriate human intervention
- Ensuring a Robust Infrastructure – Support initiatives and policies to ensure manufacturing infrastructure health and U.S. manufacturing superiority

ANNEX E: COMPONENT PROGRAM EXECUTION AND INVESTMENT FOCUS AREAS

DEFENSE-WIDE MANUFACTURING SCIENCE AND TECHNOLOGY (DMS&T) PROGRAM (OSD MANTECH LINE)

Overview

The DMS&T Program was established in response to a recommendation from a landmark 2006 DSB ManTech study.²⁶ The DMS&T Program concurrently develops manufacturing processes with emerging technologies and transitions advanced manufacturing processes and technologies for achieving significant productivity and efficiency gains in the defense manufacturing base. The program addresses cross-cutting, game changing initiatives that are beyond the scope of any one Service or Agency. It complements the other Component ManTech programs by focusing on early, emerging technologies, cross-cutting DoD priorities, and enterprise-wide, above-the-factory-floor manufacturing issues. These DMS&T initiatives are identified and ranked through road mapping and data call activities conducted in collaboration with DoD and industry manufacturing representatives and are intended to benefit multiple defense systems and platforms. The primary transition target may be a single Military Department or Defense Agency application, but there will be secondary transition targets in alternative components or applications, which will require additional assistance from those Component ManTech or acquisition programs.

Organization

The governance of this defense-wide program consists of: (1) oversight and direction by the OSD ManTech Director, within the ODASD(MIBP), (2) investment guidance by the JDMTP, and (3) day-to-day execution by the DMS&T Program Manager and individual project managers. The DASD(MIBP) is responsible for program policies and final investment and resource management decisions. The OSD ManTech Director is responsible for project justification, for overseeing and directing program

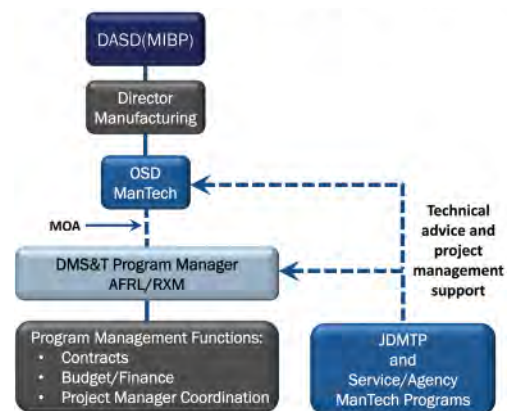


Figure E-1. DMS&T Program Organization

²⁶ Defense Science Board Task Force. The Manufacturing Technology Program: A Key to Affordability Equipping the Future Force. Department of Defense. Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics. Washington, DC, 2006.

management activities, and for ensuring technical objectives are met. The DMS&T Program Manager supports the OSD ManTech Director as the DMS&T Program's executing agent. The OSD ManTech Director and DMS&T Program Manager lead a team of project managers and jointly work with industry and the acquisition community to ensure technology transition plans are developed and that projects are effectively implemented. The JDMTP acts as a technical advisory board for the DMS&T Program and supports the DMS&T Program Office in identifying investment topics and in guiding business cases and transition strategies.

Initiatives

The following are examples of recent and current technology initiatives within the DMS&T portfolio:

- Ceramic matrix composite (CMC) manufacturing: demonstrate the advancement of manufacturing technologies for advanced turbine engines that result in significantly reduced weight, increased engine performance and fuel efficiency, and decreased maintenance.
- Custom composite orthotics and prosthetics manufacturing: Integrate advanced manufacturing processes and materials to produce custom composite orthotics and prosthetics for armed service amputees
- Advanced Manufacturing Enterprise: a set of robust manufacturing strategies and integrated capabilities that dramatically reduce the cost and time of producing complex systems in today's global manufacturing enterprises.
- Fixed and rotary wing aircraft structures: transform the way that airframes are constructed to significantly improve manufacturing cycle time and cost, and to make them less capital-intensive.
- Conformal load bearing antennas: enable the use of CLAS to increase antenna performance over conventional aircraft antennas by significantly reducing the manufacturing cost and lead times.
- Solder-free electronics: develop alternative materials and/or processes for fabrication and repair of electronic assemblies.
- Chip scale atomic clock: improve the affordability and production rate of chip scale atomic clocks, which enable the operation of C4ISR systems even when GPS is unavailable.
- JSF sensor hardening: Implement methods during wafer production to harden electro-optical sensors against lasers.
- Large affordable substrates: Increase the diameter and yield of CdZnTe substrates for high performance infrared focal plane arrays.

Successes

The OSD DMS&T Program delivers results across the Department. The 3D Airfoil Inspection project developed a 3DAI system that expedites the inspection process by scanning an airfoil and creating an associated point cloud that is then compared to the CAD file for errors and tolerances. Inspection times were reduced by over 93%, from one hour to about 2-4 minutes, and lifetime cost avoidance is estimated to be \$26 million.

The Prosthetics & Orthotics Manufacturing Initiative dramatically improved the quality and comfort of sockets for lower extremity prosthetic systems. It enabled prosthetists at military and civilian hospitals to produce lighter, more durable, more comfortable sockets using automated processes. The automated braider developed under this project provides 40% cost savings over traditional methods and has been purchased by central prosthetic fabrication houses.

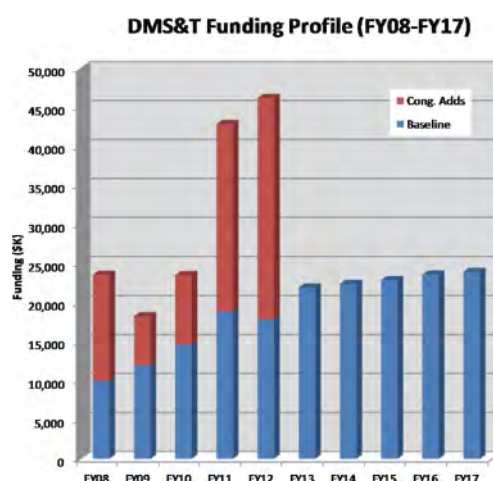
Potential DMS&T Future Investment Topics

A primary goal of the DMS&T Program is to mature materials and process technologies alongside associated technology development activities, thus ensuring that technology maturity activities are paced by manufacturing maturity activities, reducing cycle time and creating more affordable defense systems. The following are examples of future investment topics with manufacturing requirements in which there are planned technology development efforts and for which there are multi-service implementation paths.

- Direct Digital Manufacturing of Polymers, metals, or electronics
- Advanced Manufacturing Enterprise / Digital Thread
- Fiber Placement OOA large scale demonstration
- SiC High Temperature Power Devices
- Manufacturing for Ballistic Survivability and Lethality
- Manufacturing for Repair
- High-precision forming/stamping of metallic components
- Microwave curing of composite materials

Investment Profile

DMS&T invests in technology initiatives and specific projects that focus on cross-cutting military manufacturing needs for critical metals, composites, electronics, and manufacturing process technologies. The program was funded at \$42 million in FY2011 (including congressional interest items), and will average over \$22 million from FY12-17.



Summary

The DMS&T Program satisfies an essential need within the DoD manufacturing enterprise, attacking cross cutting, multi-

Defense-Wide Manufacturing Science and Technology (PE 0603680D8Z) \$K										
	Appropriated					President's FY13 Budget				
	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17
Baseline	10,000	11,981	14,638	18,916	17,888	21,966	22,407	22,913	23,610	23,963
Cong. Adds	13,594	6,299	8,908	24,000	28,375					
Total	23,594	18,280	24	42,916	46,263	21,966	22,407	22,913	23,610	23,963

service manufacturing gaps and developing material Processing and Fabrication solutions in parallel with associated technology development efforts. The program has been able to substantially affect affordability, cycle time, and performance. DMS&T represents the sole OSD-directed manufacturing technology program, and it continues to build an investment portfolio delivering game-changing capabilities within the defense manufacturing enterprise.

ARMY MANTECH PROGRAM

Overview

Army Manufacturing Technology (ManTech) Program's mission is to provide affordable and timely manufacturing solutions that address the highest priority needs of the Army. ManTech exists to reduce manufacturing affordability and producibility risks to enable transition of critical technologies to weapon systems platforms. The program accomplishes this through demonstration of effective, efficient and adaptable processes and encourages strong internal and external partnerships.



Organization

The Deputy Assistant Secretary of the Army for Research and Technology (DASA R&T) has overall responsibility for the Army ManTech Program. Within this office, system portfolio directors provide oversight and coordination of ManTech consistent with Science and Technology (S&T) portfolio areas.

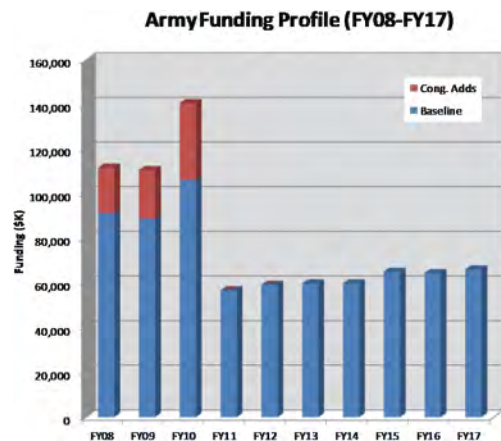
The U.S. Army Research, Development and Engineering Command (RDECOM), a subordinate command of the Army Materiel Command (AMC), has been further designated as the Army's ManTech Program Manager. The Programs and Engineering (P&E) Office within RDECOM performs this function and provides direction to the Army's S&T Organizations. ManTech managers in these organizations are responsible for coordination with project managers for the execution of individual projects. This structure allows the Army to take advantage of system level technical expertise by maintaining close contact with both the acquisition managers and the corresponding technology managers. This approach seeks to maximize technology transition by maintaining a balanced portfolio aligned with S&T, Programs of Record and Department of the Army priorities.

Investment Strategy

The investment strategy for the Army ManTech Program is to address relevant requirements to maximize technology transition. RDECOM engages with the Army S&T community, program executive officers (PEOs), program managers (PMs) and industry to strengthen ManTech products in support of Army priorities. Annual investment topics are identified by

	Army (PE 0708045A) \$K									
	Appropriated					President's FY13 Budget				
	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17
Baseline	91,305	88,975	106,259	56,816	59,297	59,908	59,952	65,150	64,550	66,183
Cong. Adds	20,442	21,698	34,401	0	0					
Total	111,747	110,673	140,660	56,816	59,297	59,908	59,952	65,150	64,550	66,183

stakeholders and proposals addressing these topics are submitted through the S&T Organizations to RDECOM. ManTech efforts are vetted and prioritized through a series of reviews and criteria-based evaluations. The review process includes evaluations by the Joint Defense ManTech Panel (JDMTP), Army S&T stakeholders, relevant program offices and the Army ManTech Program Office. Evaluation criteria are centered on alignment with the prioritized investment areas, the strength of the projected transition, the estimated return on investment and the benefit to the Soldier. Final project selection is coordinated with RDECOM leadership and DASA(R&T).



Investments are strategically organized by the following portfolios: (Figure E-2)

GROUND SYSTEMS - to include survivability, intelligent systems, unmanned systems, vehicle power and mobility, precision munitions and deployable force protection;

COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS - to include communications, intelligence and electronic warfare, sensors and mission command systems;

SOLDIER SYSTEMS - to include Soldier loading, medical systems, and human dimensions;

ADVANCED MANUFACTURING INITIATIVES - “above the shop floor” technologies to include supply chain and model-based enterprise activities.

AIR SYSTEMS - to include operations and support, survivability, rotors and flight controls, platform technologies and unmanned systems;

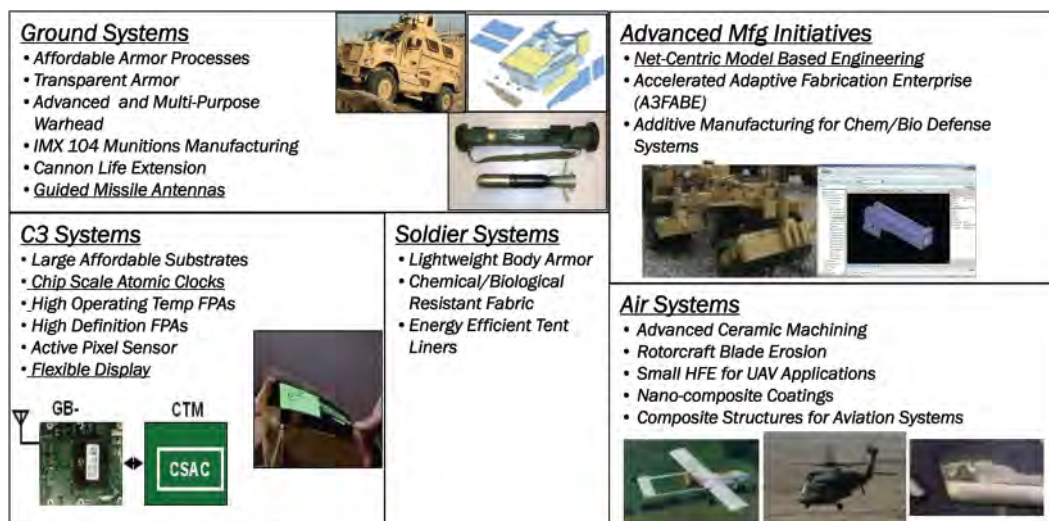


Figure E-2. Army ManTech Investment Portfolios

Program initiatives

One of the highest priorities for the Army is lightening the Soldier's load. An example of Army ManTech's strategy in support of this priority is enabling hybridized manufacturing processes for lightweight body armor. The objective is to develop an integrated suite of manufacturing technologies based on recent material and process advances that can deliver the same level of protection with at least 10% reduction in total system weight. The strategy for ManTech investments brings a three-fold approach to bear on the problem: enabling processes for improved ceramic compositions; new processes for enhancing performance and reducing assembly costs of polymer-based composite backings; and new integration and consolidation methods to deliver maximize ballistic efficient of all constituent materials. This program is continuously coordinated with PM SPIE (Soldier Protection and Individual Equipment) under PEO Soldier. to ensure relevance to specific weight reduction requirements and identify and enable body armor solutions. Direct coordination with the industrial base ensures that a manufacturing capability is mature, stable, and significant enough to warrant PM SPIE investment in issuing a new specification for improved body armor.

This same strategy was utilized to achieve success in the award winning completed Army ManTech project, "Improved Warfighter Protection" through helmet manufacturing. The Army Research Lab, in close collaboration with the Natick Research, Development and Engineering Center (NSRDEC) and PM SPIE, used Army ManTech and leveraged Small Business Innovation Research (SBIR) funds to address technology barriers that enabled the use of these new helmet materials. These barriers included preforming and thermoforming technologies associated with thermoplastic composite materials (in contrast to the existing domestic manufacturing base which is optimized for thermoset materials). The project attained a Manufacturing Readiness Level (MRL) of 8 and was instrumental in supplying production-representative helmet shells for ballistic evaluation by PM SPIE. The technology was transitioned through a Technology Transition Agreement (TTA) with PM SPIE, and manufacturing specifications were transferred by the PEO to all helmet manufacturers as part of the implementation strategy. This technology, due to the processes developed and demonstrated by the ManTech Program, has already been successfully fielded to the Special Operations Forces (SOF) as the FAST (Future Assault Shell Technology) helmet, and the Enhanced Combat Helmet (ECH) is currently in First Article Testing. Cost benefits are estimated at \$88.3M, with an ROI projected at 16.6 to 1, based on the Army ManTech investment of \$5.7M. However, the key impact of the Army helmet ManTech program is unprecedented levels of performance – over 37% higher fragment stopping power – over current Army Combat Helmets.

Additional details on these efforts and others can be found at www.armymantech.com.

Summary

Army ManTech addresses Army requirements by employing sound processes that stress affordability and producibility. In doing so, the program demonstrates alignment with DoD ManTech strategic goals and serves as a key enabling mechanism for transitioning critical technologies to the Warfighter.

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NAVY MANTECH PROGRAM

Overview

The Navy ManTech Program provides for the development of enabling manufacturing technology and the transition of this technology for the production and sustainment of Navy weapon systems. Customers range from the acquisition program managers (PMs) and industry responsible for transitioning major Navy weapon systems from development into production, to the logistics managers at the naval depots and shipyards responsible for repair, overhaul, and remanufacture of major weapon systems.



Organization

The Navy ManTech Program is managed by the Office of Transition within the Office of Naval Research (ONR), with direct oversight from the Chief of Naval Research. ONR's Office of Transition is composed of transition-centric programs including ManTech, Future Naval Capabilities (FNCs), Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR), and other transition initiatives. (Figure E-3).

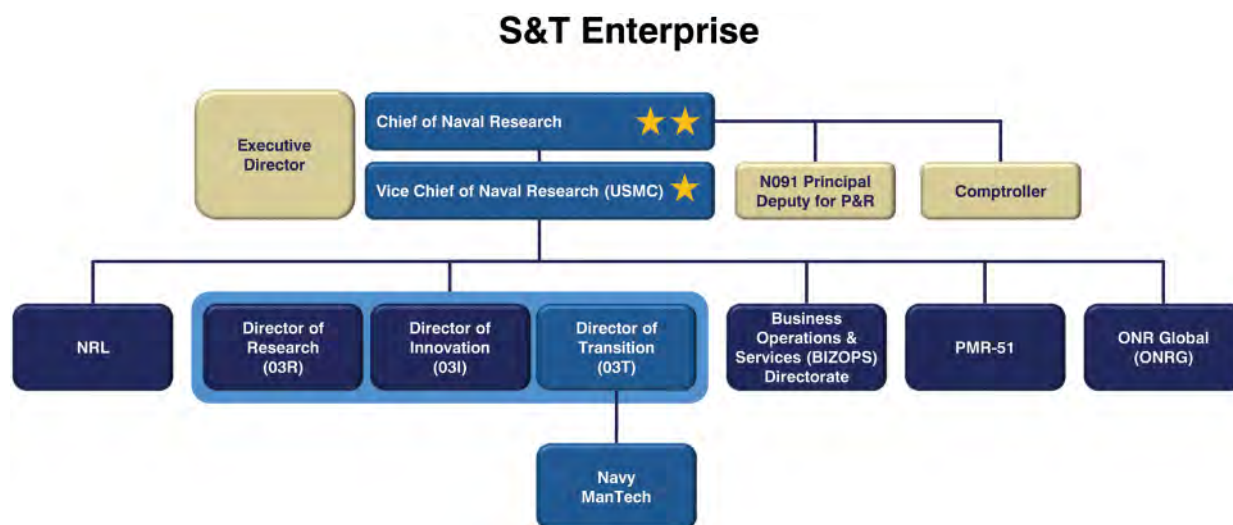


Figure E-3. ONR Organization

The Navy ManTech Program executes through its Centers of Excellence (COEs) with expertise in specific technology areas. ManTech's nine COEs are: Benchmarking and Best Practices Center of Excellence (B2PCOE) (Philadelphia, PA); Center for Naval Shipbuilding Technology (CNST) (Charleston, SC); Composites Manufacturing Technology Center (CMTC) (Anderson, SC); the Electro-Optics Center (EOC) (Freeport, PA); Electronics Manufacturing Productivity Facility (EMPF) (Philadelphia,

PA); Energetics Manufacturing Technology Center (EMTC) (Indian Head, MD); Institute for Manufacturing and Sustainment Technologies (iMAST) (State College, PA); Navy Joining Center (NJC) (Columbus, OH); and Navy Metalworking Center (NMC) (Johnstown, PA).

Service Focus

Reducing the acquisition cost of current and future platforms is a critical goal of the Navy. As a result, in 2006, ManTech adopted an affordability investment strategy and is currently focused on affordability improvements for four major shipbuilding acquisition platforms: DDG Family (DDG 1000 and DDG 51), CVN 78 Class carrier, Littoral Combat Ship (LCS), and VIRGINIA Class Submarine (VCS). Additionally, Navy ManTech has recently added a secondary affordability focus for the Joint Strike Fighter (JSF). Navy ManTech aids these five key programs in achieving their respective affordability goals by transitioning needed manufacturing technology which, when implemented, results in a cost reduction or cost avoidance (measured as a per-hull or per-aircraft cost reduction).

Successes

Since switching to its affordability focus in 2006, Navy ManTech has impacted and is continuing to impact both ship and submarine affordability and, more recently, has begun to impact aircraft affordability as well. ManTech has established good working relationships with relevant program offices and industry and has established a detailed internal planning effort. Affordability assessments on a per-platform basis, bought off by both the relevant program offices and industry, show good cost reduction potential, and ManTech's transition rate for projects is increasing. Affordability projects continue to transition and be implemented on factory floors, and cost reduction values are 'booked' by industry for these programs. For ongoing platform portfolios, platform affordability assessments, bought off by both the relevant program office and industry, show good cost reduction potential.

Recent Navy ManTech projects that have been recognized for outstanding accomplishments include advanced fiber placement of bismaleimide (BMI) material for JSF and manufacturing improvements for the Surface Electronics Warfare Improvement Program (SEWIP) Block 2 system for CVN 78 Class carrier and DDG 51 Class destroyer. In the JSF project, Navy ManTech teamed with industry to optimize the automated fiber placement (AFP) process for the carbon fiber BMI material used for the JSF wing skins to reduce weight and improve operational performance. With an investment of approximately \$3M, this effort led to increased lay-down rates of BMI AFP fabrication for both the wing skins and nacelle structure and eliminated the need for additional composite fabrication machinery and tooling. The manufacturing protocols and support fabrication technology were inserted real-time into the production of flight hardware for all three versions of the JSF aircraft - CV, STOVL, and CTOL. Savings are expected to total \$100M as recognized by VADM Venlet, Program Executive Officer – F-35 Lightning II Program:

"ManTech's \$3M investment in BMI placement has produced substantial efficiencies in our manufacturing processes. This includes a 50% reduction in part cycle time and 300% improvement in fiber lay-down rates. These efficiencies stand

to not only reduce aircraft production costs, but also reduce the need for additional composite machinery and tooling. In all, the efficiencies gained through this ManTech initiative are expected to reduce F-35 program costs by \$100M over the next 25 years.”

*VADM David J. Venlet, Program Executive Officer - F-35 Lightning II Program,
30 September 2011*

The second recent Navy ManTech success concerns manufacturing improvements for the SEWIP Block 2 system for the CVN 78 Class carrier which results in a total cost reduction of more than \$1M per CVN hull. In this project, Navy ManTech used advanced electronic component integration technologies and high tolerance machining techniques to produce high performance RF electronics modules for the SEWIP Block 2 system. ManTech demonstrated that RF modules can be manufactured with much tighter tolerances, resulting in a reduction of 70 - 95% for the tune, test, and alignment labor required in the manufacture of several RF modules. Tune, test and alignment labor is one of the most significant cost drivers in the production of military RF and microwave electronics. In addition to implementation on the CVN 78 Class carrier, this technology will be implemented on the DDG 51 Class destroyer.

Program Initiatives

Although different in focus, scope, and size, the five affordability initiatives (DDG Family, CVN 78 Class Carrier, LCS, VCS, and JSF) function similarly. For each, ManTech has established an IPT with representatives from Navy ManTech, the platform program office, and representative industry. The IPT meets regularly to coordinate and review the portfolio and ensure that projects are completed in time to meet the platform’s window of opportunity for implementation.

Taking the VCS initiative as an example, extensive interaction and cooperation between Navy ManTech, the COEs, General Dynamics Electric Boat, Huntington Ingalls Industries – Newport News Shipbuilding, PEO (Subs), and the PMS 450 Program Office has resulted in a focused ManTech initiative that continues to successfully transition manufacturing technology resulting in affordability improvements for VCS. The current VCS ManTech portfolio contains approximately 70 projects and has a potential cost savings of over \$37 million per hull. To date, twenty-three of the ManTech affordability projects have completed and have either been implemented or are in some phase of implementation. Realized cost savings of over \$21 million per hull have been recognized by the program office and General Dynamics Electric Boat. These real acquisition cost savings have been negotiated into the Block III VIRGINIA Class submarine procurement, and a process has been established to achieve further savings during future submarine acquisitions. Recently, Navy ManTech has expanded its affordability focus to include reduction of Total Ownership Cost (TOC) and is actively supporting the VIRGINIA RTOC (Reduction of Total Ownership Cost) effort. With this expanded focus on TOC reduction, ManTech is looking forward to continuing its partnership with PEO(Subs), PMS 450, and the VCS primes to significantly impact VIRGINIA affordability.

Program Reviews

The Navy ManTech Program schedules periodic program reviews for each of the affordability portfolios. In these reviews, the platform's IPT assesses the overall portfolio as well as individual projects with respect to technical progress, cost and schedule progress, and probability of implementation in time to meet the platform's window of opportunity.

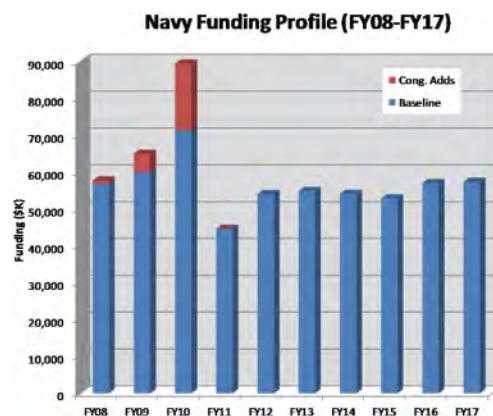
Affordability Assessments. To review progress towards meeting both platform and ManTech affordability goals, affordability assessments are conducted semi-annually. In these assessments, cost avoidance/savings per project as well as estimated total savings per platform are identified and approved by both the program office and the industry implementing the technology.

Technology Transition Plans. For each project, a Technology Transition Plan (TTP), which highlights the path from the technology development that ManTech performs to implementation on the factory floor, is developed. Implementation actions, roles and responsibilities, and required resources are identified. TTPs are signed by Navy ManTech, the relevant COE Director, a management representative of the industrial facility where implementation will occur, the program office, and, if appropriate, the technical warrant holder.

Investment Profile

Funding for the Navy ManTech Program is approximately \$55 million per year within the FY12-FY17 timeframe. Funding has remained relatively stable for the past ten years and is expected to continue at approximately that level. Congressionally directed funding is relatively small, as shown in the table.

Strategic planning is an ongoing effort. Navy ManTech annually analyzes acquisition scenarios/plans to determine major ship and aircraft acquisition programs that might benefit from a close partnership with



	Navy (PE 0708011N) \$K									
	Appropriated					President's FY13 Budget				
	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17
Baseline	56,862	59,976	71,277	44,626	54,031	54,879	54,133	52,846	57,014	57,371
Cong. Adds	868	5,032	18,189	0	0					
Total	57,730	65,008	89,466	44,626	54,031	54,879	54,133	52,846	57,014	57,371

Navy ManTech. Platforms for investment are determined by total acquisition funding, stage in acquisition cycle, platform cost reduction goals, and cost reduction potential for manufacturing.

Summary

With affordability as its focus, Navy ManTech is committed to working with acquisition programs and industry to provide the technology needed to reduce production costs. The continued collaboration of ManTech, program offices, and industry on cost-reduction opportunities can and will help platforms achieve their affordability goals.

AIR FORCE MANTECH PROGRAM

Overview

Air Force ManTech develops, demonstrates, and transitions advanced manufacturing processes and technologies to reduce costs, improve quality/capability, and shorten cycle times of weapon systems during design, development, production, and sustainment. The program's major tenets are: improvement of manufacturing processes and technologies; collaboration with government acquisition program offices, industry, and academia; investments in technologies that can be applied to different applications and systems that are beyond a reasonable risk level for industry alone; and customer commitment for implementation. ManTech objectives are achieved through partnerships at all industry levels, from large prime contractors to small material and parts vendors.



ManTech's vision of "attaining next-generation agile manufacturing" (Figure E-4) reflects a studied review of stakeholder needs and Air Force priorities, coupled with a growing national consensus that an aggressive and transformative manufacturing approach is necessary to meet critical Air Force capabilities. The vision has four strategic thrusts: (1) Moving Manufacturing Left, (2) A Cradle-to-Cradle Digital Thread, (3) A Responsive, Integrated Supply Base, and (4) Factory of the Future. More specifically, these thrusts call for: a greater up-front



Figure E-4. Airforce ManTech Vision

awareness of manufacturing readiness issues and opportunities; highly innovative approaches to overcoming defense-unique production challenges during the research, design, production, and sustainment of a system, seamlessly supported by digital information; the ability to rapidly and affordably produce smaller lots of more specialized systems across global

supply networks; as well as advanced physical manufacturing operations that intelligently manage environmental footprints and long term impacts

Organization

AF ManTech resides within AF Materiel Command (AFMC) and is a division of the AF Research Laboratory's (AFRL) Materials and Manufacturing Directorate. The Materials and Manufacturing Directorate is one of nine technical Directorates in AFRL. Oversight of AFRL activity lies with the Deputy Assistant Secretary of the Air Force for Science, Technology, and Engineering (SAF/AQR).

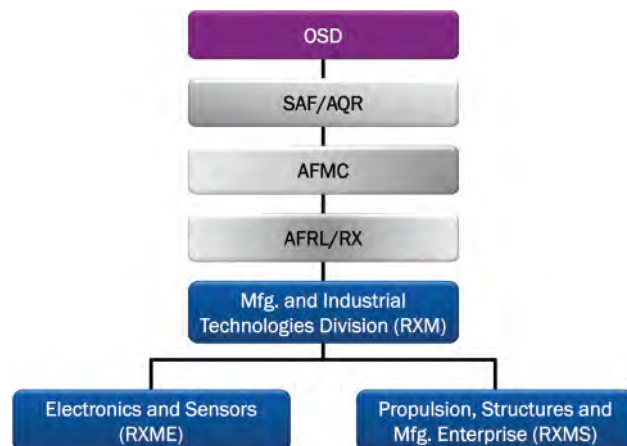


Figure E-5. Airforce ManTech Organization

Service Focus

Air Force ManTech's near-term efforts include affordability and producibility improvements for advanced turbine engines, stealth, depot efficiencies, space solar cells, and advanced radar. Air Force ManTech is also pursuing a long-term strategy for more affordable systems based on helping achieve a new level of efficiency and agility in the US industrial base. Priorities are set based on higher headquarters strategic guidance (e.g. AF Strategic Plan, AF S&T Strategy), assessments of acquisition and AFRL program requirements, and insight into industry opportunities (such as IR&D).

Successes

AF ManTech has a long history of boosting Air Force capabilities. These investments have reduced acquisition costs by billions of dollars. For example, the 1980s project Retirement for Cause successfully implemented life extension technologies for turbine engines and saved over \$500 million within 10 years and continues to lower costs today. A few recent examples of success in producibility, affordability, and capability are provided below.

Seal Extrusion Development and Demonstration (SEDD). The SEDD program developed door seals with a thermo-plastic extrusion process and certified to both the F-22 and F-35 requirements. The number of fabrication tools were reduced from 30 cast tools to 1 extrusion tool for 30 seal shapes. The new F-22 extruded seal is 15 times more durable than the baseline seal material. Overall cost avoidance for SEDD is estimated to be \$881M. The extrusion techniques are also applicable to the production of tape, which will result in future production cost avoidance for the F-35 of an additional \$100M.

Digital Radiography for NDE. Non-Destructive Evaluation (NDE) of aerospace castings during qualification and production is expensive and time consuming. The cost of film used in traditional radiographic techniques has been rising 9-20%

per year over the past 5 years due to decreasing demand for film from the medical industry, (due to conversion to digital) and the increasing price of silver, which is used in the manufacture of radiographic film. The Air Force and the Defense Logistics Agency have collaborated with industry, industry associations, and academia to work together with ASTM to create the required standards for digital reference radiographs and eliminate other barriers to implementation of digital radiography. Implementation requirements (including training) were standardized via an Industry Guidelines Document (soon to be ASTM certified) to ensure parts could transition to digital inspection under a unified aerospace specification, reducing cost of conversion. In addition to industry standardization benefits, this investment will result in approximately \$26M in cost reductions for DoD cast components over the next 10 years.

Inlet Duct Robotic Drilling. Manually drilling inlet ducts for the F-35 aircraft is ergonomically difficult and requires excessive tooling, labor costs, and long cycle time. Automated hole drilling cells will speed production and improve product quality. The new inlet duct robotic drilling (IDRD) cells, installed and operational in 2010, will meet full-rate production capability for the F-35 by 2014. The production rate of one shipset per day will result in a 75% reduction in drilling cycle time (from 50 to 12 hours per duct), resulting in savings in excess of \$40M for the F-35 program.

Multi-Junction Space Solar Cells. U.S. manufacturers of multi-junction space solar cells are facing international competition, and more demanding power, mass and volume requirements for Defense spacecraft. Air Force ManTech and the Space and Missile Systems Center (SMC) collaborated with solar cell manufacturers to mature manufacturing processes and accelerate insertion of space qualified high efficiency multi-junction solar cells. Through the ManTech Program, solar cell manufacturers were able to increase power levels from <15kW per system to 30kW per system, while reducing the solar array size and mass by 15-17% and the cost per watt by 15-20%.

Manufacturing Readiness Levels. AF ManTech has partnered with the JDMTP to advance the use of Manufacturing Readiness Levels and Assessments (MRLs/MRAs). AF ManTech members lead a JDMTP working group, formed in 2004, to develop and refine MRL criteria and tools. MRA training successfully transitioned to the Air Force Institute of Technology. AF ManTech has led MRAs to baseline manufacturing maturity and to identify associated risks on various Acquisition Category-1 (ACAT-1) programs, such as MQ-9 Reaper, and on AFRL's high-visibility Advanced Technology Demonstrators.

Initiatives

The Advanced Manufacturing Propulsion Initiative (AMPI) is expected to transform the U.S. propulsion supplier base by increasing the affordability of current technologies and raising the manufacturing readiness level of advanced materials to enable high performance engine designs. AMPI is focused on technologies enabling increased performance and maintenance cost reductions. This joint service, collaborative effort involving the three prime turbine engine contractors and their key suppliers, is using the F-35 engine as a demonstration target. AF ManTech, DMS&T, SBIR and other funding are going after a potential \$9 billion worth of cost avoidance and 321 lbs per engine of weight savings.

High Velocity Maintenance (HVM) is an AFMC initiative to increase aircraft throughput through the depot maintenance process by maximizing touch labor density, and improving scheduling and maintenance planning processes by increasing awareness of the aircraft condition prior to induction. ManTech is deploying technologies such as a Measurement and Replication System (MARS) to locate and drill attach points on replacement panels and components and advanced borescope technologies that will enable successful implementation of HVM.

Program Reviews

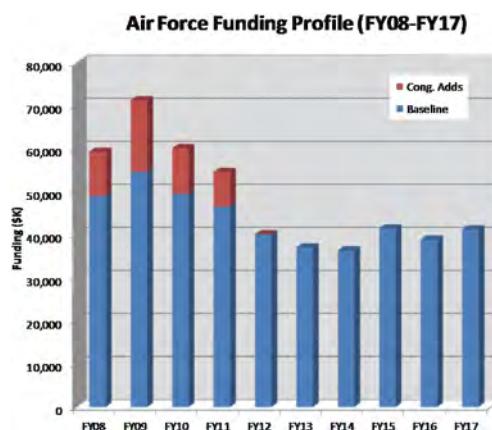
Program Initiation. New programs formulated by the ManTech Division are approved by the Materials and Manufacturing Directorate Executive Group. New programs are also reviewed at SAF/AQR program management reviews held annually to provide investment strategy guidance. Any new projects are examined by a directorate-level Technical Review Board to ensure technical plan quality and to stimulate collaboration with the S&T community. Each program is required to create an implementation plan in collaboration with product stakeholders which matures through the life of the program.

Program Progress. The Air Force follows a multi-tiered assessment schedule. A Laboratory Management Review process governs and monitors any changes to baseline technical, cost, and schedule throughout the year and culminates in an annual ManTech Division review that also examines MRL and status against program implementation plans.

Investment Profile

The Air Force's investments support activities across all Air Force product lines including: Aeronautical; Armament; Directed Energy Systems; Command & Control; Intelligence, Surveillance & Reconnaissance (C2ISR) Electronics; and Space Systems.

Funding for the Air Force ManTech Program is stable at approximately \$40 million per year across the FY09-FY17 timeframe. Congressionally directed funding is moderate, averaging \$12 million per year (FY08-FY10) as shown in the above table. In FY09, the AF Manufacturing Technology Program transferred to PE 0603680F,



Air Force (PE 0603680F) \$K										
	Appropriated					President's FY13 Budget				
	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17
Baseline	48,987	54,614	49,507	46,564	40,103	37,045	36,353	41,444	38,884	41,233
Cong. Adds	10,280	16,647	10,589	8,000	0					
Total	59,267	71,261	60,096	54,564	40,103	37,045	36,353	41,444	38,884	41,233

Manufacturing Technologies, from PE 0708011F, Industrial Preparedness, to enhance the program's ability to work technology transition opportunities and to improve balance among near and far term priorities.

Summary

The Air Force Manufacturing Technology Program is a warfighting capability and system affordability multiplier. Serving as the AF enterprise program to work strategic issues and opportunities in manufacturing readiness, it has a proven record of boosting performance and cutting cost and schedule in acquisition and sustainment. AF ManTech will continue to pursue high-return opportunities across the acquisition and sustainment spectrum.

DEFENSE LOGISTICS AGENCY (DLA) MANTECH PROGRAM

Overview

DLA's Research and Development activities are funded through two program elements that are aligned to the eight major supply chain areas. The two program elements are: Logistics Research and Development (PE 0603712S) and Manufacturing Technology (PE 0708011S). DLA ManTech supports a portfolio of investments



in six of the eight DLA supply chains. ManTech is focused on strengthening the DLA industrial base associated with the subsistence, clothing and textiles, construction and equipment, maritime, land, and aviation supply chains (Figure E-6). Logistics R&D is focused on internal DLA business processes and the intersection of private sector and DLA business processes. ManTech's focus and current investment in each area is depicted in purple background.

PE0708011S - Industrial Preparedness (DLA Industrial Base Focus) “ManTech” - \$22.526M				PE0603712S - Generic Logistics R&D (DLA Business Process Focus) “Log” - \$23.291M			
Subsistence	Clothing & Textiles	Medical	Energy	Const/ Equip	Maritime	Land	Aviation
Combat Rations Network \$1.722M	Customer Driven Uniform Mfg. \$3.776M	Medical Logistics Network \$2.794M	Energy Readiness \$3.604M	Castings \$2.310M			
				Forgings \$1.101M			
				Weapon System Sustainment \$5.558M			
				Material Acquisition Electronics \$11.900M			
				Battery Network \$1.717M			
Supply Chain Enablers							
Supply Chain Management \$3.501M							
Strategic Distribution and Reutilization \$5.563M							
Defense Logistics Information Research \$2.271M							
PE0605502S- Small Business Innovation Research 2.6 of Annual Appropriation							

Figure E-6. DLA Industrial Base Focus

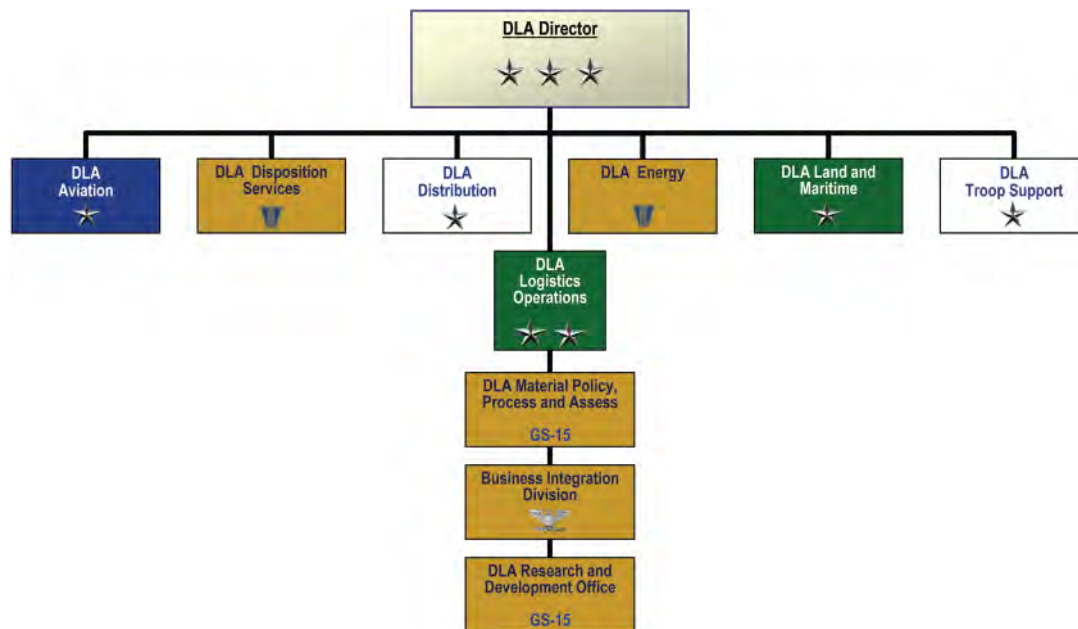


Figure E-7. DLA R&D Organizational Placement

Organization

DLA ManTech resides in the J-3 Logistics Operations (Figure E-7). J-3 is responsible for the end-to-end supply chain management of the DLA's eight supply chains, providing logistics and materiel process management policy, guidance, oversight, and monitoring of supply chain performance. Within J-3 DLA ManTech falls under J-335, the Business Integration Division. J-335 coordinates and administers the transformation of processes, methods, and metrics of all policies under the purview of J-33.

Each ManTech investment must be sponsored by a DLA-assigned Flag Officer, or DLA-assigned member of the Senior Executive Service. Proposed investments are then vetted throughout the DLA enterprise. DLA ManTech projects directly support the DOD ManTech Strategic Plan in key areas that are directly related to the DLA mission.

Agency Focus

The Defense Logistics Agency supplies the nation's military services and several civilian agencies with the critical resources they need to accomplish their worldwide missions. DLA provides wide-ranging logistical support for peacetime and wartime operations, as well as emergency preparedness and humanitarian missions. DLA supplies almost every consumable item America's military services need to operate, from meals to jet fuel. In short, if America's forces can eat it, wear it, drive it, or burn it, chances are that DLA helps provide it. DLA also helps dispose of materiel and equipment that is no longer needed.

Successes

The Key Performance Indicator for DLA ManTech is implementation of project results. Results from each ManTech Supply Chain portfolio investment have been implemented.

Microcircuit Emulation Program. A microcircuit's lifecycle is typically 3-5 years, but a DoD system lifecycle is 10 years or more. This life cycle mismatch can result in production line shutdowns, constant redesign, and non-mission capable equipment when microcircuits are unavailable from the original manufacturing source. To combat this, DLA ManTech has established a trusted, continuing flexible manufacturing capability with supporting reverse engineering, design, test, and packaging for qualified form, fit, and function microcircuits. This is an onshore ability to support more than 350 unique weapon systems with a cost avoidance over \$500 million.



Combat Rations Program. DLA's program to improve Meals-Ready to Eat (MREs), the food that powers our combat forces, involves every manufacturer of rations. The results have been an enormous improvement in the cost, quality, and acceptability of combat rations. Prior to the DLA ManTech Program for MREs, the menu was limited to stews and similar items that could be pumped into MRE pouches. Although nutritious, these "pumpable" meals were not as satisfying as whole meat items. The ManTech Program developed the packaging machinery that enables whole meat products to be cost-effectively included in combat ration menus.

Castings and Forgings Program. These programs work on a variety of problems affecting the ability of foundries and forges to meet DoD requirements. First and foremost, the programs have identified tooling needed to make DoD parts. By identifying the source of the original casting or forging tooling, the original foundry or forge can supply the item either to DLA directly or to another manufacturer for finishing into the final product.

Apparel Research Network. The program has fielded technology that links the military recruit into the supply chain that supplies the items they receive in basic training. The technology is implemented in over 300 manufacturers and allows for very accurate tracking of clothing items from the manufacturer to the recruit induction center. It is deployed in 8 of 9 recruit centers.

Initiatives

Counterfeit Parts. Improve detection, deterrence and disposition of non-conforming/counterfeit materiel is a top Agency Priority. DLA is working with industry to develop technologies to reliably identify genuine parts quickly and cost effectively.

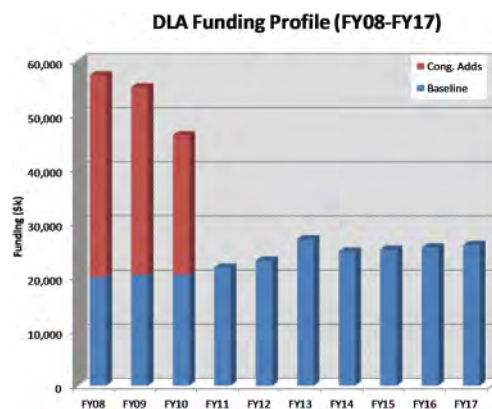
Model Base Enterprise. Teaming with the Army and NIST, DLA is working to transition to a model based approach for spare parts procurement.

Program Reviews

DLA employs a standard and repeatable process for ManTech Projects. Each project must have a General Officer or member of the Senior Executive Service Sponsor who signs the project's charter. All projects are approved by the R&D Board, chaired by the Director of Logistics Operations, and made up of the Senior Executives from each supply chain and Staff Office. During project execution the program manager maintains a continuing dialog with the Sponsor. The R&D Board reviews project progress and approves "go – no go" milestone decisions and the decision to transition from R&D to a production environment.

Investment Profile

DLA's ManTech Program has been in place since FY83, and has an average funding of \$22 million over the FY12-FY15 timeframe. The adjacent table shows DLA's ManTech funding profile, including the congressionally added funding. DLA's ManTech investment portfolio is distributed across the supply chains as shown in figure 1.



Defense Logistics Agency (PE 0708011S) \$K										
	Appropriated					President's FY13 Budget				
	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17
Baseline	20,114	20,480	20,514	21,798	23,103	27,044	24,781	25,151	25,551	25,979
Cong. Adds	37,233	34,650	25,757	0	0					
Total	57,347	55,130	46,271	21,798	23,103	27,044	24,781	25,151	25,551	25,979

Summary

DLA ManTech continues to refine its ability to respond quickly and effectively to the needs of the military. With a history of progress in manufacturing technologies and processes, DLA ManTech's future will see continued success in acquisition best practices and manufacturing process development.

ANNEX F: DEFENSE ADVANCED RESEARCH PROJECTS AGENCY (DARPA) ADAPTIVE MANUFACTURING INITIATIVE

Overview

The Defense Advanced Research Projects Agency (DARPA) was established in 1958 to prevent strategic surprise from negatively impacting U.S. national security and create strategic surprise for U.S. adversaries by maintaining technological superiority of the U.S. military.



DARPA has invested in adaptable manufacturing technologies throughout its history, with programs like Project Agile in 1962 that led to rapid fielding of the Army's M16 Assault Rifle (Figure F-1); the Very High Speed Integrated Circuit (VHSIC) program in the 1980s that helped lay the groundwork for the development of the modern integrated circuit industry; the Free Form Fabrication program in the 1990's that helped develop key technologies that led to today's digital direct manufacturing (3D printing); the Multi-Missile Manufacturing (M3) program that helped develop common infrastructure for different classes of missiles, and the Disruptive Manufacturing and Accelerated Insertion of Materials programs in the first decade of the 21st century, that have developed new composites and metals guided by computational design and new processing capability.

Today, DARPA is developing adaptive manufacturing methodologies, tools and processes that target weak seams across the lifecycle of military system development, from molecules to missions. Previous DARPA investments in materials and microelectronics have established the foundations for entire industries that now lie at the center of the production base for critical defense and commercial systems.



Figure F-1. DARPA-sponsored field evaluation of the Colt AR-15 rifle led to adoption of the lightweight high-velocity 5.56 mm M16 rifle.

This section describes how DARPA views and implements its strategic role in the creation and dissemination of advanced powerful design, production and qualification methodologies for defense manufacturing. DARPA's "Adaptive Make" strategy is building new tools to organize, create, validate, and culturally integrate new design methods with technology and with the dynamics of the research process.

DARPA Adaptive Make Organization

Adaptive Make's molecules-to-missions investment portfolio, distributed across DARPA's technology offices with common inter-office coordination, emphasizes speed of development with better management of complexity across many scales, comprising biological systems, materials and structures, components and systems. The relative scale of these portfolio categories from FY11 and estimated FY12 budgets is illustrated in Figure F-2. DARPA is an active participant, along with NSF, NIST and OSD ManTech in the President's Advanced Manufacturing Partnership (AMP) multi-agency and multi-industry steering group. As an ex-officio member of the Joint Defense ManTech Panel (JDMTP), DARPA coordinates its investment portfolio with the OSD ManTech investments of the Military Services, DLA and OSD.

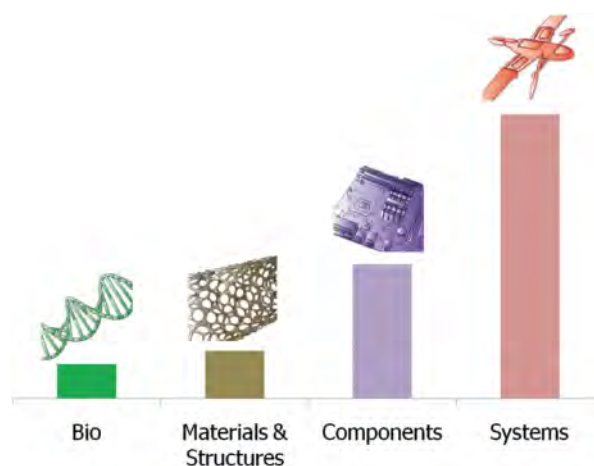


Figure F-2. Relative scale of combined FY11 & requested FY12 investment thrust areas that form the 5-year Adaptive Make portfolio

Strategic Vision for DARPA Adaptive Make

DARPA believes that “to innovate, we must make, and to protect we must produce.” In 2009, DARPA embarked on a five-year roadmap in adaptive manufacturing, known as Adaptive Make. Adaptive Make's portfolio totals an estimated one billion dollars in investments. *Controlling for time* forms the core of DARPA's strategic vision for adaptive manufacturing. Adaptive Make seeks to enable the defense industry to dramatically shorten the timeline from idea to production, while actively managing the complexity of military systems. Rapid development enables adaptation to emerging threats, facilitates insertion of new technologies and accelerates innovation. Implementing this strategic approach involves new methodologies, tools and processes.

DARPA Adaptive Make Motivation

Trends in US weapon system development indicate that it is taking too long for the U.S. to develop new capabilities. Other countries often develop and field systems in significantly shorter time frames. This is illustrated in Figure F-3, depicting the number of years from program start to Initial Operating Capability (IOC) for a number of U.S. and non-U.S. weapon systems since 1945. The blue line shows U.S. systems; the red line is associated with non-U.S. systems. This divergent

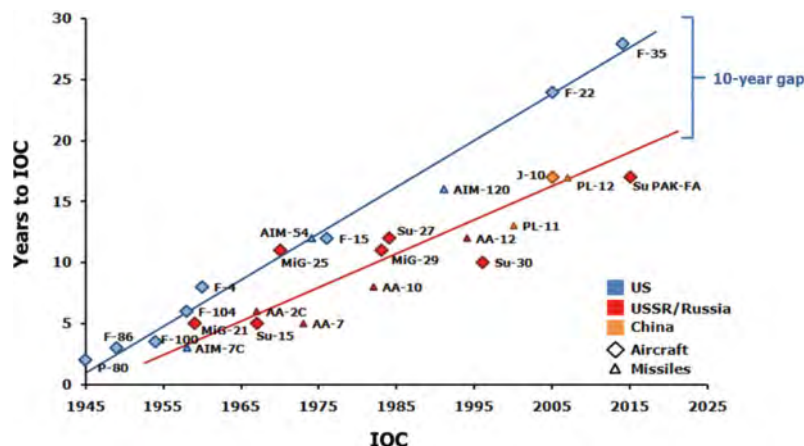


Figure F-3. Time to Initial Operating Capability (IOC), a measure of the time to develop a new system, from 1945 to 2025 (projected).

trend is approaching a ten year gap between the time it takes us to field a new system as compared to the time it takes our potential adversaries. While additional time is required for the U.S. to build systems to defend warfighters, others increasingly rely on simpler, commercially available technology that could disrupt sophisticated systems and enable them to adapt more quickly.

Extended timelines cause problems that are projected into cost, risk and complexity, while current manufacturing methodologies impose avoidable

restraints on the speed, diversity and number of innovations. The inability to manage complexity and access a wide base of innovations, with speed and flexibility, is addressable by science and technology solutions and inform Adaptive Make's R&D investment perspective.

DARPA Adaptive Make Themes

Adaptive Make comprises a broad R&D investment portfolio with programs ranging across these thrust areas and crossing many scientific, technical and application domains. Many Adaptive Make programs also share some common themes, though they may be implemented in radically different ways. Some of these strongly recurring implementation themes include the following:

Foundry-inspired, platform-based design. Developed partly by DARPA investments in the 1980s, it now forms the bedrock of the integrated circuit industry. In 1980 Carver Mead and Lynn Conway published a best-selling college textbook, *Introduction to VLSI System Design*, from DARPA-funded research, which allowed college students to design computer circuitry without the need to own and operate a semiconductor production facility. Mead and Conway's design tools enabled scalable, model-based design and verification to tease apart design problems from fabrication problems so they could be addressed separately by different teams, yet integrated together to make products. Current Adaptive Make

programs, including Adaptive Vehicle Make, Open Manufacturing, Living Foundries and Manufacturable Gradient Index Lenses, are consciously adopting lessons in open architecture, shareable infrastructure and design analysis tools from earlier successes with adaptable manufacturing of computer chips.

Prize-based challenges. DARPA continues to build on a recent tradition of prize challenges that includes the DARPA Grand Challenge, Urban Challenge, Network “Red Balloon” Challenge and Shredder Challenge with new Adaptive Make challenges planned for the future. Prize-based challenges build on a heritage from early 18th-century England, where innovators like the clockmaker John Harrison solved the problem of establishing the East-West position, or longitude, of a ship at sea. The problem was considered so intractable that the British Parliament offered a prize that would be comparable to several million dollars today. Today, Adaptive Make capitalizes on the same entrepreneurial spirit in FANG, a team-based challenge to develop a ground combat vehicle with requirements based on those of the USMC’s Amphibious Combat Vehicle.



Game-ification. Some types of complex design problems can be solved more rapidly by combining powerful computer tools with the help of large numbers of innovators, than by using computer analysis alone. DARPA is learning to “game-ify” these problems (converting them into puzzle form that leverage natural human problem-solving abilities) and then deploying them to massive multiplayer game systems on the Internet, in a technique sometimes called “crowd-sourcing.” A protein related to HIV infection in rhesus monkeys that had resisted computer analysis for fifteen years was recently solved by players of Foldit, a DARPA-funded physics-based design game, confirmed by x-ray crystallography and selected for scientific publication.

Rapid-qualification methodologies and tools. Engineers have learned by experience that sophisticated computer analysis is not powerful until the results can be trusted to match design predictions. Adaptive Make programs like Open Manufacturing are developing new design and producibility analysis tools with simulations that are validated by empirical data.

Collaboration tools. Adaptive Make programs are developing collaborative methods to enable reliable, secure and trusted sharing of infrastructure, sharing of intellectual property (IP), verification of designs and planning of production logistics. System programs like UAVForge and vehicleforge.mil are creating online venues for innovators to collaboratively develop, review, submit and critique radical new system concepts.

Computational design tool chains. DARPA is leveraging high performance computers to help design entirely new classes of materials from first principles and use those new materials to design producible components. Adaptive Make is employing multi-domain analysis of system performance to enable “correct-by-construction” designs that not only work right the first time they are built but are inherently producible because they are informed by knowledge linked to real production processes.

DARPA Adaptive Make Programs

The following is a summary of just a few of the many DARPA current Adaptive Make program investments, that apply common themes in rapid, adaptable manufacturing to solve militarily-relevant problems in particular scientific and technical domains:

Blue Angel H1 Influenza Acceleration Program, a Bio thrust program, has turned the tobacco plant into a reconfigurable bioreactor for mobile, adaptable and ultra-fast production of vaccine-quality proteins. Blue Angel successfully demonstrated the large scale production of protein under Good Manufacturing Practices (GMP) in the time frame that needed to adapt to rapidly changing viruses like influenza (H1N1).

Living Foundries, another Bio thrust program, is developing the engineering framework and technologies for scalable biomanufacturing. Today, biomanufacturing is constrained to long development cycles (currently seven years or more), large research and development costs (\$50M-\$500M), and simple, existing bio-products, limiting its utility. Living Foundries aims to develop and apply an engineering framework to biology that decouples biological design from fabrication, yields design rules and tools, and manages biological complexity through simplification, abstraction and standardization. .

Maskless Nanowriter, a components thrust program, attempts to make small-lot fabrication of high performance integrated circuits (ICs) affordable and to increase write speed on the semiconductor wafer. Today's method of fabricating integrated chips using ultraviolet light requires increasingly expensive and inflexible mask sets whose costs have risen to several million dollars per set. Such mask costs are compatible with high volume commercial lithography, but for small-lot DoD applications such mask costs are unaffordable and become a disincentive to incorporating state of the art circuits into the latest weapon systems. The solution is to eliminate the need for these high cost mask sets. The new direct-write Maskless Nanowriter tool has potential for achieving the required performance capability by simultaneously using a million parallel, individually-controlled electron beams created using a new reflection electron beam patterning technology.

Adaptable Sensor System (ADAPT), another components thrust program, is leveraging commercial platform-based design and production techniques similar to those used on Apple iPhones and Google Android devices to compress development and “make” timelines for intelligence, surveillance, and reconnaissance (ISR) sensors from the current average of three to eight years, to under two years.

Manufacturable Gradient Index Optics (M-GRIN), a Materials thrust program, is developing novel fabrication technology for flexible and inexpensive optical manufacturing. The idea is to take stacks of thin films of polymer or glass, where each individual film has a different index of refraction, and fuse and mold them with heat and pressure into a single



Figure F-4. M-GRIN optical assemblies can be smaller and more robust than standard optics.

composite lens. M-GRIN technology seeks to reduce the number of lenses in a complex optical assembly, such as in telescope, and enable a 5 - 10x reduction in weight and size (Figure F-4). This should make high-quality optics like soldier night-vision goggles smaller, lighter, faster to develop and economical and enable new optical systems not currently possible with conventional lenses.

Adaptive Vehicle Make (AVM), a System thrust program, is actually a family of related programs including META, Instant Foundry Adaptive through Bits (iFAB), Fast, Adaptable, Next-Generation Ground Vehicle (FANG), and MENTOR that is aimed at compressing by at least five-fold the development timelines for complex cyber-electro-mechanical military systems such as military vehicles. AVM is adopting a foundry-inspired infrastructure, with final assembly at the Joint Manufacturing Technology Center at Rock Island Arsenal, and flexible intellectual property licensing approaches



Figure F-5. Adaptive Vehicle Make will build tools and methodologies to enable teams of distributed developers to pursue prize-based challenges to design and manufacture a military ground combat vehicle.

to enable model-based, open-source development of fully integrated mission-capable systems. AVM's prize-based challenges culminate in development of a Marine Corps amphibious fighting vehicle (Figure F-5). META aims to democratize the design process for complex cyber-electro-mechanical systems and FANG will test it through a series of amphibious fighting vehicle design prize challenges open to large numbers of designers. The vehicleforge.mil effort will enable large numbers of independent innovators to collaboratively design militarily relevant systems on an open source hosting site. MENTOR, a high school STEM outreach effort, aims to deploy programmable manufacturing equipment to 1,000 schools and engage students in distributed digital manufacturing. The goal is to inspire a new generation of designers and manufacturing innovators, and demonstrate end-to-end integration of a model-based design process.

Open Manufacturing (OM), a Materials thrust program, is investing in rapid, adaptable, and qualifiable fabrication processes; manufacturing design, simulation and performance prediction tools; and approaches to reduce impediments to accelerated qualification and certification of guaranteed performance of manufactured items throughout their lifecycle. Open Manufacturing complements AVM and other material-related manufacturing efforts by developing tools for qualifying processes and products using a wide variety of different fabrication approaches.

UAVForge, a Systems thrust program, is a DARPA-Space and Naval Warfare Systems Command (SPAWAR) collaborative initiative to design, build and manufacture an advanced small unmanned air vehicle (UAV) system. UAVForge seeks to

outperform conventional development by facilitating the exchange of ideas among a loosely connected international community of individuals united through common interests and inspired by innovation and creative thought. Anyone with Internet access around the globe can go to the UAVForge.net website and submit a solution, offer subject matter expertise or peer-review ideas posed by other participants. A professional manufacturer will promote manufacturability and top solutions will compete in a well-defined fly-off scenario.

Summary

The summaries above represent a sampling of Adaptive Make's numerous ongoing manufacturing-related programs, in full partnership with industry, academia and government. DARPA has established a fifty-year track record of leading advances in development of smaller, lighter, faster technologies, production methodologies, processes and tools that have reshaped global industries that depend on efficient, adaptable manufacturing. DARPA's Adaptive Make campaign is redefining the art of the possible, reinventing the way military systems of the future will be manufactured, and revolutionizing the way America fights. DARPA's performers are, along with other research and development agencies in the DoD and U.S. Government, its collaborating partners in reinvigorating American manufacturing.

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ANNEX G: REFERENCES

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ANNEX H: ACRONYMS AND ABBREVIATIONS

3D	three dimensional
3DAI	three dimensional airfoil inspection
ACAT	Acquisition Category
ADAPT	Adaptable Sensor System
AESA	active electronically scanned array
AF	Air Force
AFMC	Air Force Materiel Command
AFP	automated fiber placement
AFRL	Air Force Research Laboratory
AFRL/RX	Air Force Research Laboratory, Materials and Manufacturing Directorate
AIA	Aerospace Industries Association
AMC	Army Material Command
AME	Advanced manufacturing enterprise
AMNPO	Advanced Manufacturing National Program Office
AMP	Advanced Manufacturing Partnership
AMPI	Advanced Manufacturing Propulsion Initiative
ARA	Acquisition Resources and Analysis
ASD(A)	Assistant Secretary of Defense for Acquisition
ASD (L&MR)	Assistant Secretary of Defense for Logistics and Material Readiness
ASD(NCB)	Assistant Secretary of Defense for Nuclear, Chemical, and Biological Defense
ASD(OEP&P)	Assistant Secretary of Defense for Operational Energy Plans & Programs
ASD(R&E)	Assistant Secretary of Defense for Research and Engineering
ASTM	American Society for Testing and Materials
AVM	Adaptive Vehicle Make
B2PCOE	Benchmarking and Best Practices Center of Excellence
BBP	Better Buying Power
Bio	biological

BIZOPS	Business Operations and Services Directorate, ONR
BMI	bismaleimide
C2ISR	command and control intelligence, surveillance, and reconnaissance
C3	command, control and communications
C4ISR	command, control, communications, computers, intelligence, surveillance and reconnaissance
CAD	computer aided design
CAPE	Cost Assessment and Program Evaluation
CFIUS	Committee on Foreign Investment in the United States
CLAS	Conformal Load-bearing Antenna Structures
CMC	ceramic matrix composite
CMTC	Composites Manufacturing Technology Center
CNR	Chief of Naval Research
CNST	Center for Naval Shipbuilding Technology
COE	center of excellence
CTOL	conventional takeoff and landing variant of the JSF
CV	carrier variant of the JSF
CVN	Nuclear Powered Aircraft Carrier
CdZnTe	Cadmium Zinc Telluride
DARPA	Defense Advanced Research Projects Agency
DASA(R&T)	Deputy Assistant Secretary of the Army for Research and Technology
DASD	Deputy Assistant Secretary of Defense
DASD(DT&E)	Deputy Assistant Secretary of Defense for Developmental Test and Evaluation
DASD(IP)	Deputy Assistant Secretary of Defense for Industrial Base Policy
DASD(MIBP)	Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy
DASD(R)	Deputy Assistant Secretary of Defense for Research
DASD(RF)	Deputy Assistant Secretary of Defense for Rapid Fielding
DASD(SE)	Deputy Assistant Secretary of Defense for Systems Engineering
DAU	Defense Acquisition University
DDG	Guided Missile Destroyer
DDR&E	Director of Defense Research and Engineering
DEPSECDEF	Deputy Secretary of Defense

DfM	design for manufacturability
DIRCM	directional infrared countermeasures
DLA	Defense Logistics Agency
DMS&T	Defense-wide Manufacturing Science and Technology
DPA	Defense Production Act
DPAC	Defense Production Act Committee
DPAP	Defense Procurement Acquisition Policy
DPAS	Defense Priorities and Allocations System
DoD	Department of Defense
DoDD	Department of Defense Directive
DoE	Department of Energy
DSB	Defense Science Board
DTIC	Defense Technical Information Center
DTRA	Defense Threat Reduction Agency
DUSD	Deputy Under Secretary of Defense
DUSD(A&T)	Deputy Under Secretary of Defense for Acquisition and Technology
ECH	Enhanced Combat Helmet
EMPF	electronics manufacturing productivity facility
EMTC	Energetics Manufacturing Technology Center
EOC	Electro-Optics Center
EXCOM	S&T Executive Committee
FANG	Fast Adaptable Next-Generation Ground Vehicle
FAST	Future Assault Shell Technology
FNC	future Naval capabilities
FY	fiscal year
FYDP	Future Years Defense Program
GAO	Government Accountability Office
GEIA	TechAmerica/Government Electronic Industries Alliance
GMP	Good Manufacturing Practices
GPS	global positioning system
H1N1	a type of influenza commonly called “swine” flu

HFE	heavy fuel engine
HIV	Human Immunodeficiency Virus
HVM	High Velocity Maintenance
IB	industrial base
IBIF	Industrial Base Innovation Fund
IC	integrated circuit
IDRD	inlet duct robotic drilling
iFAB	Instant Foundry Adaptive through Bits
iMAST	Institute for Manufacturing and Sustainment Technologies
IMU	inertial measurement unit
IOC	Initial Operating Capability
IP	intellectual property
IPT	integrated process team
IR	infrared
IR&D	independent research and development
IR/EO	infrared/ electro-optics
ISR	intelligence, surveillance, and reconnaissance
J-3	DLA Logistics Operations
J-33	DLA Material Policy, Process and Assessment
J-335	DLA Business Integration Division
JCS	Joint Chiefs of Staff
JDMTP	Joint Defense Manufacturing Technology Panel
JLOE	Joint Lines of Effort
JMAP	Joint ManTech Action Plan
JRAC	Joint Rapid Acquisition Cell
JSF	Joint Strike Fighter
KM	knowledge management
LCD	liquid crystal display
LCS	Littoral Combat Ship
Li-ion	Lithium ion
LWIR	long wave infrared sensors

M3	Multi-Missile Manufacturing
ManTech	Manufacturing Technology
MARS	Measurement and Replication System
MBE	Model Based Enterprise
MDA	Missile Defense Agency
MEMS	micro-electromechanical systems
MENTOR	Manufacturing Experimentation and Outreach program
META	DARPA AVM design tool
M-GRIN	Manufacturable Gradient Index Optics
MIBP	Manufacturing and Industrial Base Policy
MMIC	monolithic microwave integrated circuits
MOA	memorandum of agreement
MRE	meal ready to eat
MRL	manufacturing readiness level
MSSC	Manufacturing Skill Standards Council
MT	Manufacturing Technology
NACFAM	National Council for Advanced Manufacturing
NASA	National Aeronautics and Space Administration
NCAT	National Center for Advanced Technologies
NCDMM	National Center for Defense Manufacturing and Machining
NCMS	National Center for Manufacturing Sciences
NDAA	National Defense Authorization Act
NDE	non-destructive examination
NDIA	National Defense Industrial Association
Net-centric	network centric
NIST	National Institute of Standards and Technology
NJC	Navy Joining Center
NMC	Navy Metalworking Center
NNMI	National Network for Manufacturing Innovation
NSF	National Science Foundation
NSRDEC	Natick Research, Development and Engineering Center

NSTC	National Science and Technology Council
NRL	Navy Research Laboratory
ODASD(MIBP)	Office of the Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy
OEM	original equipment manufacturer
OM	Open Manufacturing
ONR	Office of Naval Research
ONRG	Office of Naval Research Global
OOA	Out of Autoclave
OSD	Office of the Secretary of Defense
OT&E	Operational Test and Evaluation
PCAST	President's Council of Advisors on Science and Technology
PDUSD(AT&L)	Principle Deputy of the Under Secretary of Defense for Acquisition, Technology and Logistics
PE	program element
P&E	Programs and Engineering (part of RDECOM)
PEO	program executive office or program executive officer
PL	Public Law
PM	program manager
PMR	Program Manager (Research)
PMS	Program Manager (Ships)
PPBES	Planning, Programming, Budgeting, and Execution System
PQM	production, quality, and manufacturing
QDR	Quadrennial Defense Review
R&D	research and development
RDECOM	Research, Development, and Engineering Command
REACH	Registration, Evaluation, Authorization, and Restriction of Chemicals
RF	radio frequency
ROI	return on investment
RTOC	Reduction in Total Ownership Cost
S2T2	Sector-by-Sector, Tier-by-Tier
S&T	science and technology
SAE	Senior Acquisition Executive

SAF/AQR	Deputy Assistant Secretary of the Air Force for Science, Technology, and Engineering
SBIR	Small Business Innovation Research
SECDEF	Secretary of Defense
SEDD	Seal Extrusion Development and Demonstration
SEWIP	Surface Electronics Warfare Improvement Program
SiC	silicon carbide
SiC/GaN	silicon carbide/gallium nitride
SiC PiN	intrinsic semiconductor region between a p-type semiconductor and an n-type semiconductor region
SID	System Integration Domain
Sm. Bus.	Office of Small Business Programs
SMC	Space and Missile Systems Center
SME	Society of Manufacturing Engineers
SOF	Special Operations Forces
Sp. Prgms	Special Programs
SPAWAR	Space and Naval Warfare Systems Command
STEM	science, technology, engineering, and math
STOVL	short take off and vertical landing variant of the JSF
STTR	Small Business Technology Transfer
TARA	Technology Area Review and Assessment
TFT	Technology Focus Team
TOC	Technical Operations Council also Total Ownership Cost
TTA	technology transition agreement
TTP	technology transition plan
UAV	Unmanned Aerial Vehicle
UAVForge	Crowdsourcing for UAV Innovation
U.S.	United States
USC	United States Code
U.S.C.	United States Code
USD(AT&L)	Under Secretary of Defense for Acquisition, Technology, and Logistics
USD(C)	Under Secretary of Defense Comptroller

USD(I)	Under Secretary of Defense for Intelligence
USD(P)	Under Secretary of Defense for Policy
USD(P&R)	Under Secretary of Defense for personnel and Readiness
USMC	United States Marine Corps
VADM	Vice Admiral
VCS	Virginia Class Submarine
VED	vacuum electronic device
VHSIC	Very High Speed Integrated Circuit
VLSI	Very Large Scale Integration
WBG	wide band gap